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The fungi of Ontario

III Parasitic microfungi on vascular plants in Northern Ontario

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The fungi of Ontario

III Parasitic microfungi on vascular plants in Northern Ontario

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Research Branch
Agriculture Canada
1983

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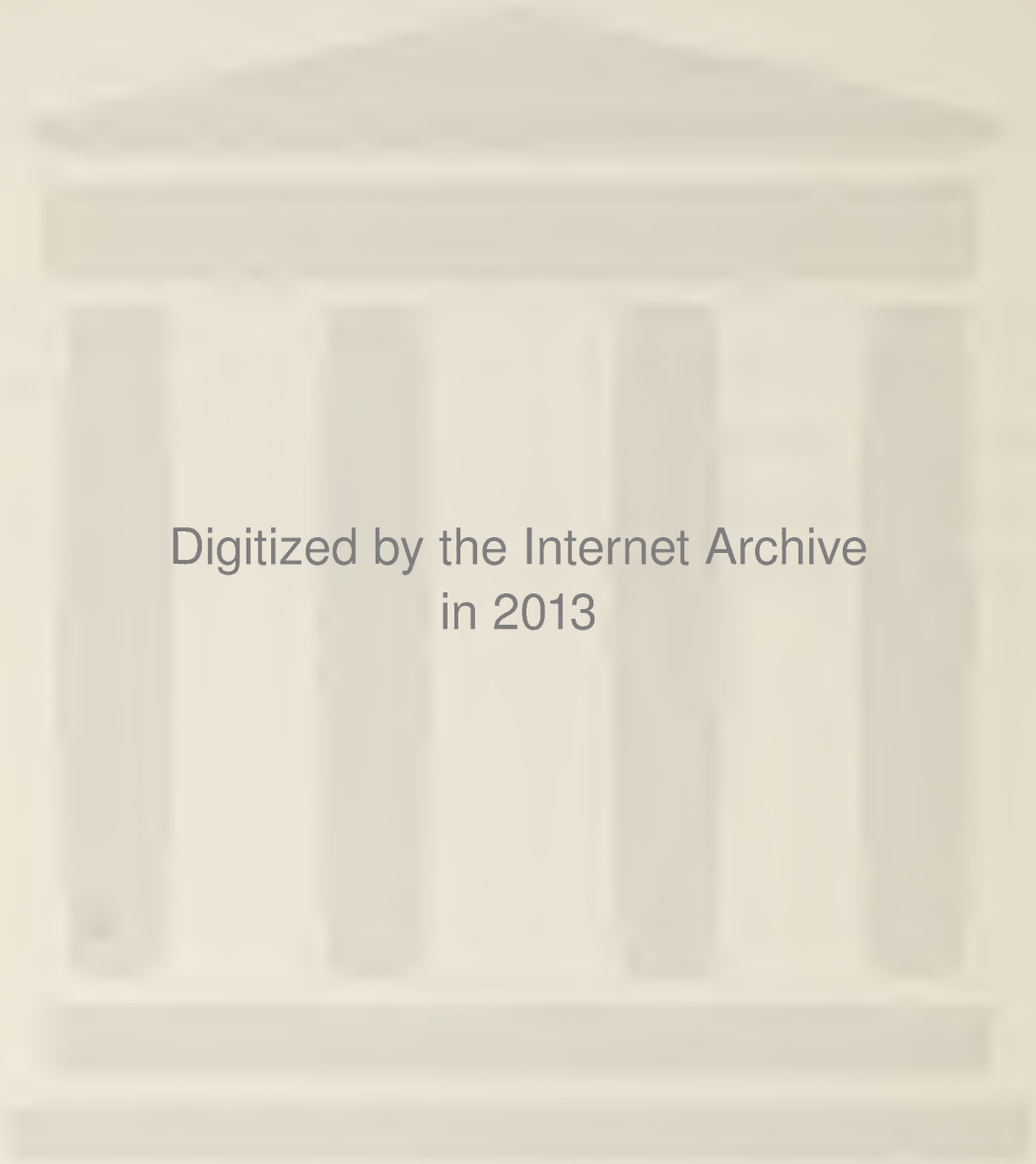
ABSTRACT

An annotated listing of the parasitic fungi in Ontario north of latitude 48° is reported. A total of 263 taxa are recorded more than half of which are rusts and smuts. Significant extensions of distribution within Ontario are noted, along with new records of occurrence for the province, for Canada and for North America.

Ce travail présente une liste annotée des parasites fongiques ontariens retrouvés au nord du 48eme parallèle. On y rapporte 263 Taxas dont plus de la moitié sont des rouilles et des charbons. Ou note un accroissement significatif de la distribution de certains organismes pour l'Ontario ainsi que l'existence de nouvelles entités pour cette province, le Canada et l'Amérique du Nord.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PARASITIC MICROFUNGI ON VASCULAR PLANTS IN NORTHERN ONTARIO

INTRODUCTION

Fungi have been collected intensively in southern Ontario for over 100 years, primarily from centres of agricultural and biological interest. Northern Ontario has not had the same attention, due in part to the considerable distances of the northern area from the activity centres like Ottawa, Toronto, and London and partly to the ample mycological problems to be investigated in the south. Some collecting and studying of fungi was done in the north, around Lake of the Woods by investigators from the University of Manitoba during the 1920-30s (Bisby et al, 1928) and in the last 25 years forest mycologists and pathologists located at the Great Lakes Forest Research Centre, Sault Ste. Marie have studied the forestdisease problems of that region. Fungus specimens on deposit in that herbarium (SSMF) are listed by Pilley and Trieselmann (1968-69) in synoptic catalogues of cryptogams and by Trieselmann et al, (1974) in supplements. These listings do not contain specific localities within the province and hence are not usable here.

The Annual Reports of the Forest Insect and Disease Survey (FIDS) report various tree diseases within forest regions of Canada. The northern forest regions of Ontario mentioned in the surveys roughly corresponding to the area north of 48°N latitude are: (1) Northwestern, (2) North Central, (3) Northern, (4) Northeastern (northern part). Although the specimens upon which these reports are based are not at hand, the reports themselves are referred to where herbarium vouchers are scanty.

To date no comprehensive fungus flora of the province has been attempted and, because northern Ontario has received limited mycological investigation, a provincial treatment of the fungi should be initiated only after this shortcoming has been corrected. The purpose of this paper is to consolidate knowledge of parasitic fungi from northern Ontario based on specimens in the National Mycological Herbarium, Ottawa (DAOM), recent collections by the author and published records.

LAND FORMS AND PLANT COVER

Ontario is bounded on the north by Hudson and James Bays, and the 48th parallel is arbitrarily chosen as the southern limit for this study. The Canadian Shield is the dominant land form within these boundaries. Its northern rim passes north and south in an arc through Ogoki (Fig. 5) approximating the northern extent of the boreal forest and it tapers in southern Ontario to a narrow spur at Frontenac Co. abutting the St. Lawrence River. Natural forest cover is boreal with needleleaf trees (spruce, fir, tamarack, Jack pine) and poplar (Fig. 1) in the north except for a strip of southeastern mixed forest (needleleaf trees with broadleaf trees birch, poplar, maple) (Fig. 2) extending from Thunder Bay northwest to Lake-of-the Woods.

The Hudson Bay Lowlands lie north of the boreal forest in a band about 200-300 km wide reflecting the Hudson and James Bays coastlines and extending into Manitoba and into Quebec. Small lakes, bogs, strings of needleleaf trees and various sedges and mosses are characteristic of these forest-barren lowlands (Fig. 3). The coast of Hudson Bay from Cape Henrietta Maria into

Fig. 1 Spruce climax forest (*Picea mariana*) north of Geraldton, September 1981.

Fig. 2 Mixed forest of birch and pine (*Betula papyrifera* and *Pinus strobus*) west of Atikoken, August 1971.

Fig. 3 Aerial view of the forest-barren lowlands, Moosonee - Fort Albany, August 1972.

Fig. 4 Claybelt soil, Agriculture Canada Experimental Farm, Kapuskasing, September 1981.

INDEX TO COUNTIES AND DISTRICTS

Algama 48	Huron 16	Perth 14
Brant 8	Kenoro 54	Peterborough 29
Bruce 25	Kent 2	Prescatt 38
Carleton 40	Lambton 3	Prince Edward 24
Cochrane 53	Lanark 41	Rainy River 52
Dufferin 20	Leeds 33	Renfrew 45
Dundas 35	Lennax and Addington . . 31	Russell 39
Durham 22	Lincaln 11	Simcae 27
Elgin 4	Manitoulin 46	Stormont 36
Essex 1	Middlesex 5	Sudbury 49
Frontenac 32	Muskoka 43	Temiskaming 50
Glengarry 37	Nipissing 47	Thunder Bay 51
Grenville 34	Narfalk 6	Victoria 28
Grey 26	Northumberlond 23	Waterloo 13
Haldimand 9	Ontario 21	Welland 10
Haliburtan 42	Oxford 7	Wellington 17
Halton 15	Porry Sound 44	Wentwarth 12
Hostings 30	Peel 18	York 19

FOREST COVER

- FOREST–BARREN
- BOREAL–FOREST
- GT. LAKES–ST. LAWRENCE
- DECIDUOUS FOREST

Forest Cover simplified from Forest Regions map of Canada 1972.

Fig. 5 Outline map of Ontario to show political divisions, place names, forest cover and land forms.

Manitoba and Quebec supports a tundra plant association of arctic dwarf shrubs (birch, willow, labrador tea, blueberry) and some grasses, sedges lichens and other herbaceous plants.

The height of land on the shield lies mostly north of the 48th parallel (Fig. 5) with drainage north to Hudson and James Bays and southward to the Atlantic Ocean. One component of the northward drainage is the Abitibi River. It falls 200 metres in its 400 km run north from Lake Abitibi to the Moose River with some established power installations, including the installation at Abitibi Canyon which is utilized for the pulp and paper mills at Smooth Rock Falls and Kapuskasing. Because productive forest land in Ontario is 64% of the total land area of the province much of it in the north, the pulp and paper industry is important in such centres as the aforementioned and Cochrane, Hearst, west through Atikoken, Fort Frances, Dryden and Kenora. With the forests so widespread in the north, agriculture is limited. The claybelt extends in a 50km wide flat between Lake Abitibi and the Hearst-Kapuskasing region (Fig. 4). Here beef and dairy products supplement the forest industry. Another region between Nipigon and Thunder Bay supports dairy production and mixed livestock. Other limited agricultural regions are centred around Fort Francis - Rainy River and Kenora.

CLIMATE

The average maximum monthly temperatures from 48°N through 56°N in Ontario range from 17°C to 4°C for May, 17°C to 12°C for September with highs of 27°C to 17°C in July. In the southern part of this area, the growing season extends for about 175 days and in the northern part for about 140 days

(National Atlas of Canada 1974). Average precipitation from April to September ranges from 40 cm in the south to 25 cm at the Hudson Bay coast. The climate of northern Ontario is humid continental with cool summers while the region north and west from Moose Factory is essentially subarctic with cool short summers. Along with local weather conditions, the climatic factors interacting with land forms, topography, soil and Man's interference determine the plant cover and consequent population of parasitic fungi.

SOURCE OF MATERIAL

The foundations of this report are the fungus specimens on deposit in DAOM which date back to collections made by Macoun near Lake Nipigon in the 1890s, and are supplemented by collections by Bisby and colleagues in the first decades of the 1900s from the Kenora - Minaki area and by Plant Pathologists during 1930-40s from Kapuskasing. Because the mycoloical coverage for northern Ontario is far from complete in comparison with that for vascular plants the following vascular plant collections were systematically scrutinized for parasitic fungi: the Agriculture Canada Vascular Plant Collection, Ottawa (DAO) and the National Museum's National Herbarium (CAN) also in Ottawa. In CAN, there are abundant specimens from Hudson Bay Lowlands and Bay shores. These are accessions mainly from the studies of W.K. Baldwin (1958), I. Hustich (1955,1957), A.E. Porsild, D.R. Moir (1954), J.L. Riley (1980) and others. In DAO, collections from the expeditions of A. Dutilly, E. Lepage and M. Duman (1954-58) to the eastern (Que.) and western (Ont.) coasts of James Bay provided additional parasitic material. Some fungi from the Quebec region were reported by Dutilly et al (1958) and some of these are on

deposit in DAOM as are collections from Great Whale River, Quebec by D.B.O. Savile. Because of a similarity of terrain and plant cover in northern Quebec and Manitoba adjacent to Ontario, records from these areas are here included in square brackets []. This search yielded many parasitic fungi from the region between 51° - 56°N an area otherwide poorly collected for fungi.

In the past 10 years the author has collected at the north shore of Lake Superior, Lake of the Woods, Kenora, Pickle Lake, Black Sturgeon Lake, and the Geraldton - Cochrane area. Some collecting was done at Moose Factory and Fort Albany on western James Bay. In total, these trips include the region between 48° - 52°N and have been helpful in confirming the presence of many parasites previously suspected for the area. All specimens reported here are on deposit in the National Mycological Herbarium, Ottawa (DAOM) and selected accessions are provided.

FORMAT

The fungi are listed alphabetically by genus and species within major taxonomic groups. The latter are described very briefly to emphasize the sympton expression on the host. A total of 263 taxa are reported about half being Uredinales. In this group, the symbols 0,I,II,III represent respectively the pycnial, aecial, uredinial and telial states of these pleomorphic parasites.

Earlier treatments of Ontario fungi (Parmelee 1960, 1977) recorded fungus distribution by county (Co.) and district (Dist.) but this approach holds little meaning when referring to collection sites in Northern Ontario which has such broad political districts. Distribution is, therefore, recorded by

latitude and longitude or by place names as given on the outline map. New fungus, host, and distributional records are noted where applicable to individual species. In summary these are: new fungi for North America (1), Canada (2), Ontario (20); new hosts for individual fungi (8); significant (200 km) northward distributional extensions (30). Reference is made, where pertinent, to species illustrations in Fungi Canadenses an ongoing series of illustrations and descriptions of Canadian fungi.

Synonyms are omitted except when the binomial chosen differs from that in Bisby et al (1938) or Conners (1967).

It is well to emphasize that the parasitic fungus flora of northern Ontario is still very imperfectly known due mainly to the lack of collecting. Certain fungus taxa may indeed be absent from the region but absence cannot be assumed to be real when in fact it may be due to insufficient studies.

THE PARASITIC FUNGI

PHYCOMYCETES

CHYTRIDIALES Those members reported here cause very small single or amassed wart-like growths, on leaves and stems, that contain resting sporangia.

Physoderma lathyri (Palm.) Karling (= *Urophlyctis lathyri* (Bjorn.)Palm.) on *Lathyrus japonicus* Willd., [Baie aux Oies 53°54'N 79°04'W, Que.] causing serial, knot-like galls on stems and leaves. It is known also in Carleton Co. (DAOM 18275) in southern Ontario.

P. maculare Wallr. on *Alisma triviale* Pursh, (as *A. plantago-aquatica* L.) Moose Factory, causing spot-like brown discolorations on leaves (DAOM 15203).

Synchytrium asari Arth. & Holw. on *Asarum canadense* L., Mammamattawa River near James Bay (DAOM 184563). This is the first Canadian record but the fungus is known (DAOM) from States adjacent to Ontario.

Synchytrium sp. on *Viola pallens* Banks) Brainerd; Schreiber, N shore Lake Superior (DAOM 184562).

PERONOSPORALES The downy mildews appear as evanescent, white, cottony aerial conidia and conidiophores on the underside of leaves usually reflected on the upperside by chlorosis. Their prime sporulating condition usually occurs before the heat of the day. The separation of taxa depends mainly on these anamorphs.

Albugo tragopogonis (Pers.) S.F. Gray; on *Artemisia biennis* Willd., Cochrane (DAOM 184561).

Peronospora corydalis deBary on *Corydalis aurea* Willd.; Kenora, Minaki, Manitouwadge 49° 07'N 85°50'W.

P. leptosperma deBary on *Artemisia caudata* Michx.; Neys Prov. Park, N shore Lake Superior (DAOM 12718); not previously recorded for Canada but it is now known to occur north to the Yukon Terr. (DAOM 115750).

P. parva Gaumann on *Stellaria monantha* Hultén; [Great Whale River, Que. (DAOM 23784)].

Plasmopara halstedii (Farl.) Berl. & deToni, on *Helianthus annuus* L.; Kapuskasing. Systemic, covering most or all of leaf undersurface of young plants or localized on leaves of established plants.

P. pygmea (Ung.) Schroet. on *Anemone canadense* L.; Fort Albany (DAOM 145945). This fungus was not previously known in Ontario but was certainly known elsewhere in Canada (Conners, 1967).

P. ribicola Schroet. on *Ribes triste* Pall.; Moose Factory (DAOM 145199), causes localized leaf spots on this and at least 2 other species of *Ribes* elsewhere in Canada.

HYPHOMYCETES

These fungi appear on leaves, inflorescences, fruits and stems, as white, grey, pale yellow to brown and variously green or red aerial hyphae and conidia without protective structures.

Botrytis cinerea Pers., on *Halenia deflexa* (Sm.) Griseb., Sutton Lake (54°N 84°W) (DAOM 184535). Conidia are produced from blackish, submersed sclerotia on stems of the previous season. Reported on *Picea* and *Pinus* seedlings at Thunder Bay (FIDS for 1974).

Cercospora sp., on *Pyrola secunda* L., Nakina but doubtfully parasitic.

Cladosporium sp., on *Scirpus paludosus* Nels. var. *atlanticus* Fern., Shipsands Island near Moosonee on overwintered stems.

C. phlei (Greg.) de Vries, on *Oryzopsis asperifolia* Michx., Michipicoten Harbour (48°N 85°W) (DAOM 184564).

Cristulariella depraedans (Cke.) Hohn., on *Acer spicatum* Lam., reported by Redhead (1975) from Nonwatin Lake, Thunder Bay Dist., near Black Sturgeon Lake. Additional collections from this area, are also deposited at Toronto (TRTC), (Redhead pers. comm.) Other hosts in Ontario (DAOM) include: *A. pensylvanicum* L., *A. rubrum* L. and *A. saccharum* Marsh.

Glomopsis corni (Peck.) Henderson (= *Glomerularia corni* Pk.), on *Cornus canadensis* L., from Savant Lake, Hearst, near Smooth Rock Falls and Macleod Prov. Park near Geraldton (DAOM 184540); found also at many sites along north shore of Lake Superior. A widely distributed leaf-spotting parasite in Canada from Gaspé, Que. to Queen Charlotte Islands, B.C.

Pollaccia elegans Serv., on *Populus balsamifera* L., near Geraldton and Thunder Bay District (FIDS for 1973-74).

P. saliciperda (All. & Tub.) v. Arx, on *Salix* sp. near Sioux Lookout (FIDS for 1970).

Ramularia arvensis Sacc., on *Potentilla norvegica* L., Pickle Lake (DAOM 184543), Savant Lake and Helen Lake. *Potentilla norvegica* is a common weed in all provinces and is the main host in Canada. Other cinquefoils (*P. anserina* L.) are less commonly attacked.

R. destructiva Phill. & Plowr., on *Myrica gale* L., near Geraldton (DAOM 184541). This is a conspicuous leaf spot but it is rarely collected. Two other Canadian collections are known from Kouchibouquac, N.B. and Vancouver I., B.C. Reported by Bisby et al. (1938) from Minaki as *Ovularia d.* (Phill. & Plowr.) Massee.

R. rosea (Fckl.) Sacc., on *Salix discolor* Muhl., near Dorion on north shore Lake Superior; on *S. serissima* (Bailey) Fern., Shipsands Island near Moosonee. Known on additional *Salix* spp. elsewhere in Canada but this is a first report on *S. serissima*.

Toxosporium camptospermum (Peck) Maublanc, on *Abies balsamea* (L.) Mill., Black Sturgeon L. This fungus is apparently more saprophytic than parasitic; see Ellis (1976, p. 136).

Tubercularia vulgaris Tode see *Nectria Cinnabarina*.

COELOMYCETES

Conidial fungi often causing necrotic leaf spots, distinguished from Hyphomycetes by conidia borne on or within protective structures such as submersed or superficial globoid pycnidia or variously cup-like acervuli. Like the Hyphomycetes many, but not all, have teleomorphs in the Ascomycetes.

Ascochyta sp., on *Euphrasia hudsoniana* Fern. & Wieg., Mammamattawa on Kenogami River, junction Moose and Abitibi Rivers, [and Gillam, Man.].

Cylindrosporium prunophorae Higgins see *Blumeriella jaapii* v. Arx (Discomycetes).

Entomosporium mespili (DC.) Sacc., anamorph of *Diplocarpon mespili* (Sorauer) Sutton (Discomycetes). This is a widely distributed fungus in Canada occurring from N.S. to B.C. and it is not uncommon on other Pomoideae in the more southern areas of Canada.

Gloeosporium apocryptum Ell. & Ev., on *Acer spicatum* Lam., near Geraldton (DAOM 184548).

Hainesia borealis Ell. & Ev., on *Galium tinctorium* L., Albany River at James Bay but occurring more widely on *G. boreale* L. elsewhere in Canada, including southern Ontario.

Kabatia lonicerae (Hark.) Hohn. var. **americana** (Ell. & Ev.) Conners on *Lonicera canadensis* Bertr., near Kapuskasing (DAOM 184547).

Kabatiella apocrypta (Ell. & Ev.) v. Arx, (= *Gloeosporium apocryptum* Ell. & Ev.) on *Acer spicatum* Lam., near Geraldton.

Macrophoma tumefaciens Shear anamorph of *Cucurbitaria staphulae* Dearn. ex Arnold & Russell; see Fungi Canadenses No. 17 which describes a macroconidial state in the genus *Pseudodichomera*. Specimens in DAOM are mainly from Saskatchewan.

Marssonina **fragariae** (Lib.) Kleb. on *Fragaria virginiana* Duchesne (see teleomorph *Diplocarpon earliana* (Discomycetes)). Conidia measure 17-20 x 5-6 um, comparable in size to material from Rainy River and other Canadian collections. A second species, on same host, *M. canadensis* Bolton has spores 31-44 x 5-8 um and is known only from B.C.

M. **populi** (Lib.) Magn. on *Populus balsamifera* L. Specimens in DAOM are from Temagami southward, but there is also one report (FIDS for 1972) from the vicinity of Sioux Lookout. The ascigerous state is *Drepanopeziza populorum* (Desm.) Hohn. See Fungi Canadenses No. 15.

M. potentillae (Desm.) Magn. on *Potentilla anserina* L., west of Hearst (DAOM 184551). Infection causes a conspicuous leaf spot on a number of species of cinquefoil in Canada; the species is widely distributed but not commonly collected.

Phyllosticta ampelicida (Engelman) van der Aa (= *P. viticola* Thum.) on *Parthenocissus quinquefolia* (L.) Planch. The conidia are 8-11 x 6.5 - 8.0 um and match well the spores of Thum., Myc. Univers. no. 1393 on *Vitis vulpina* L. and Bisby's record from Kenora (10 x 6 um). The teleomorph is *Guignardia bidwellii* (Ell.) Viala & Ravaz.

P. betulae Ell. & Ev. on *Betula papyrifera* Michx., Kenora area.

P. brunnea Dearn. & Barth. on *Populus tremuloides* Michx., Kenora area

P. minutissima Ell. & Ev. on *Acer spicatum* Lam., Kenora area (DAOM 15146b) and Thunder Bay (DAOM 184567).

P. virginiana (Ell. & Ev.) Seaver on *Prunus virginiana* L., Kenora area. The above four species of *Phyllosticta* are all from Clearwater Bay near Kenora.

Septogloeum potentillae Allesch. on *Potentilla tridentata* Ait., Terrace Bay on north shore of Lake Superior. The only other Canadian record on this host is from N.S. On *P. arguta* Pursh this fungus is known only from Brant Co., Ont. based on a specimen originally issued in Barth., Fungi Col. 3487 as *Septoria purpurascens* Ell. & Martin.

Septoria aurea Ell. & Ev. on *Ribes triste* Pall., Ogoki (184552); also on other species of currents from southern Ontario. It occurs on *Ribes aureum* Pursh from Ottawa but other host species in DAOM affected with this leaf spot are mainly of western origin viz. *R. laxiflorum* Pursh, *R. nigrum* L. and *R. odoratum* Wendl. f.

S. betulae (Lib.) West. on *Betula* sp., from Kenora but known widely in Canada from Nfld. to Yukon on *B. papyrifera* Marsh. On the latter, *Septoria betulicola* Pk. is known from Nipissing District and is questionably distinct by longer conidia.

S. corylina Peck. on *Corylus cornuta* Marsh (= *C. rostrata* Ait.), Ingolf near Kenora but more common southward in Ontario from Sault Ste. Marie and Temagami.

S. flagellifera Ell. & Ev. on *Pisum sativum* L., Kapuskasing.

S. helianthi Ell. & Kell. on *Helianthus annuus* L., Kapuskasing but mostly southward.

S. increscens Peck. on *Trientalis borealis* Raf., Ingolf and Raleigh near Kenora. Leaf spots are usually evident in July but are not common.

S. oenotherae West. on *Oenothera biennis* L., Moose Factory, Atikokan and near Pickle Lake (DAOM 184553); common in southern Ontario where *O. perennis* L. bears the same leaf spot.

S. musiva Peck., on *Populus balsamifera* L., (see teleomorph *Mycosphaerella populorum).*

S. pisi West. on *Pisum sativum* L., Kapuskasing. Common, but not serious, across Canada.

S. polygonorum Desm. on *Polygonum cilinode* Michx., Pic River Thunder Bay Dist. and *P. convolvulus* L., Atikokan, Rainy River Dist.,; not previously recorded on these hosts but it is especially common in Canada on *P. persicaria* L. Recorded from Kenora by Bisby et al. (1938).

S. populicola Peck., on *Populus balsamifera* L., see ascigerous state *Mycosphaerella populicola*.

S. salicicola (Fr.) Sacc. on *Salix ?lucida* Muhl.; SE Geraldton (DAOM 184568). Conidia 35-53 x 3.2-4.0 um, 0-2 septate. The leaf spots are conspicuous and pycnidia are hypophyllous. This is a first report for the fungus in Ontario although Conners (1967) records it and 2 additional *Septoria* species from arctic sites.

S. shepherdiae (Sacc.) Dearn. on *Shepherdia canadense* (L.) Nutt., near Thunder Bay (DAOM 184569) and Kenora. Not previously recorded from Ontario but specimens in DAOM range from Kenora south to Bruce Co. and date from 1933.

S. sonchi-arvensis Dearn. & Bisby, on *Sonchus arvensis* L., Minaki. Original description of conidia: hyaline, septate, 20-42 x 2.5 um at one end and 1.5 um at the other, sometimes even. TYPE material Bisby 1573 (Dearn 5868) from Univ. Manitoba extant in Herb. Dearn. with annotations that spores are up to 56 um long and drawings to show 4 septations; notations on paratype also from Univ. Man. (Bisby 2379) indicate that *Septoria sonchifolia* is associated.

S. sonchifolia Cke. on *Sonchus arvensis* L., Minaki with spores 20-35 x 1.4-2.0 um, cylindrical, without taper and 1-3 septa. The association of the two Septorias on *Sonchus* was found repeatedly at Minaki according to Bisby *et al* (1938).

S. violae West. on *Viola* sp., Kenora. Conidia 20-40 x 1.0 - 2.0 um, 0-1- septate, filiform, hyaline, on conspicuous, pale brown leaf spots. Other Ontario specimens extend the distribution well southward.

S. waldsteiniae Peck and Clint. on *Waldsteinia fragarioides* (Michx.) Tratt., from Aubinadong R., Algoma Dist. extralimital to this study but the most northerly of only 3 Canadian collections all from Ontario. The dark circular leaf spots become more conspicuous after overwintering when by mid May they become pale almost white at the centres with a dark periphery.

Sirococcus strobilinus Preuss on *Pinus resinosa* Ait., Sioux Narrows, Sioux Lookout. This fungus is described as the causal agent of red pine shoot blight which caused concern during the early 1970s in northern Ontario (FIDS for 1973-76).

Stagonospora meliloti (Lasch.) Petrak on *Melilotus albus* Desr., Missinabi R. at 50°N (DAOM 184571), Kapuskasing. Occurs mainly on sweet clover but there are specimens in DAOM from western Canada on Medicago sativa L. and from both eastern and western Canada on *Trifolium* spp.

Tiarosporella abietis Whit., Reid and Piroz. on *Abies balsamea* (L.) Mill., Kapuskasing and Geraldton. Pycnidia appear on dead overwintered needles only. Presumably infection occurs the previous season on living needles (see Whitney et al. 1974). It has been associated in nature with the ascigerous fungus (Helotiales) *Darkera abietis* Whit., Reid and Piroz.

ASCOMYCETES

These fungi form haploid spores (2-many) within a sac-like cell or ascus. Asci may occur with or without surrounding protective tissue. Many ascomycetes have been shown to be the teleomorphs of one or more conidial fungi.

TAPHRINALES Asci form naked on leaf, fruit or surface of an excrescence and usually cause some discoloration of the host tissue.

Taphrina americana Mix, on *Betula papyrifera* Marsh., near Nakina.

T. carnea Johans. on *Betula papyrifera* Marsh., near Manitouwadge. Infection results in conspicuous leaf blisters.

T. cerasi (Fckl.) Sadeb., on *Prunus pensylvanica* L.f., near Schreiber N shore Lake Superior; the cause of witches' broom.

T. communis (Sadeb.) Gies., on *Prunus nigra* Ait., Kenora; diseased fruits are commonly called plum pockets.

T. nana Johans., on *Betula glandulosa* Michx., [Great Whale River, Que.] leaf yellows.

T. robinsoniana Gies., on *Alnus cripa* (Ait.) Pursh, Kapuskasing to Geraldton (DAOM 184494); *A. rugosa* (DuRoi) Spreng., Michipicoten (DAOM 184572), Hearst, Geraldton (DAOM 184491), Black Sturgeon L., Thunder Bay and Ft. Frances; causing tongue-like excrescences on fruiting cones.

ERYSIPHACEAE Asci are produced within a closed structure (cleistothecium) bearing few to many appendages. (cf. Parmelee 1977). Powdery mildews have a conspicuous white, powdery (*Oidium*) conidial state (cf. Boesewinkel, 1980).

Erysiphe aggregata (Peck) Farl. on *Alnus crispa* Pursh near Geraldton (DAOM 184431); *A. rugosa* (Du Roi) Spreng., Sibley near Thunder Bay (DAOM 184573), Black Sturgeon Lake, [Fort George, Que.]. The mildew is visible between the cone scales as a white cottony growth with immersed dark cleistothecia.

E. cichoracearum DC.: Mérat, on *Achillea millefolia* L., *Aster ciliolatus* Lindl. (DAOM 184432), *A. macrophyllus* L., *A. simplex* Willd., *A. tradescantia* L., *Eupatorium maculatum* L. (DAOM 184434), *Hieracium aurantiacum* L., *H. canadense* Michx., *Lactuca biennis* (moench.) Fern., *Mentha arvensis* L., *Mertensia paniculata* (Ait.) G. Don (DAOM 184437), *Plantago major* L., *Scutellaria laterifolia* L., *Solidago canadensis* L. with specimens from Smooth Rock Falls, Moosonee and Fort Albany west to Lake of the Woods and L. attawapiskat. Some hosts e.g. *Mertensia* are often made conspicuous by this mildew.

E. graminis DC.: Mérat on *Poa glauca* Vahl, *P. palustris* L., P. pratensis L. Michipicoten and Atikoken north to Moosonee, Lake River, Big Trout Lake and Sandy Lake See Fungi Canadensis No. 71.

E. polygoni DC.: Mérat, on *Anemone canadense* L., *Chelone glabra* L., *Oenothera biennis* L., *Polygonum achoreum* Blake, *Ranunculus acris* L. (DAOM 184444), *Trifolium pratense* L. Foleyet and Ft. Francis north to Moosonee, Sioux Lookout and Kenora. Mainly on Polygonaceae and Ranunculaceae but hosts in other families are also attacked.

Microsphaera penicillata (Wallr.: Fr.) Lév., on leaves of: *Alnus rugosa* (Du Roi) Spreng. (DAOM 184445), *Betula papyrifera* Marsh. (DAOM

184449) first collection of this mildew on this host in Ont., although Conners (1967) has recorded it on *Betula* sp. from Man.; *Lathyrus ochroleucus* Hook. (DAOM 184574), *Lonicera hirsuta* Eaton, *L. involucrata* (Richards.) Banks, *Viburnum t r bbum* Marsh. Our holdings range southward from Missinabi River (50°48'N) and Lake Nipigon.

M. vaccinii (Schwein.) Cke. & Peck, on *Epigaea repens* L., *Vaccinium angustifolium* Ait. (DAOM 184453), *V. myrtilloides* Michx. (DAOM 184457), near Timmins, Michipicoten and Thunder Bay north to Abitibi Canyon, Lake Nipigon and Savant Lake.

Phyllactinia guttata (Wallr.: Fr.) Lév., on *Acer rubrum* L., *A. spicatum* Lam., both are single collections from Thunder Bay District and new records for Ontario; *Alnus crispa* (Ait.) Pursh. *A. rugosa* (Du Roi) Spreng. (DAOM 184467) the latter often also infected with *Microsphaera penicillata* with its conspicuously smaller cleistothecia; *Betula borealis* Spach, *B. occidentalis* Hooker, *B. papyrifera* Marsh.(DAOM 184468); *Cornus alternifolia* L., *C. stolonifera* Michx. (DAOM 184476); *Corylus cornuta* Marsh. with collections only from the region around Lake of the Woods; *Fraxinus nigra* Marsh. and *F. pensylvanica* Marsh. The most northerly specimens are on *Betula* spp. from the western James Bay Watershed about 51° and 52°N. Large ascocarps, bulbous-based appendages and stalked asci bearing only 2 ascospores characterize this mildew.

Podosphaera clandestina (Wallr.: Fr.) Lév., on *Amelanchier alnifolia* (Nutt.) Nutt., *A. laevis* Wieg. *A. sanguinea* (Pursh) DC., from vicinities

of Michipicoten and Kenora but mainly southward on these and other Rosaceous hosts including *Malus*. The genus is characterized by dichotomously branched appendages and cleistothecia each with a single large ascus with 6-8 ascospores. In this species appendages are ± equatorial. The cultivated apple also takes *Podosphaera leucotricha* (Ell. & Ev.) Salm. a species which has longer appendages ± fasciculate from the upper half of the ascocarp.

Sphaerotheca fuliginea (Schlecht.: Fr.) Poll., on *Bidens frondosa* L., *Draba arabisans* Michx., *Erigeron canadensis* L., *Taraxacum officinale* Weber (DAOM 184459) from vicinity of Foleyet, Sibley Peninsula and Rainy River north to Pickle Lake. Commonly on Asteraceae but also on other host families southward. Similar to Erysiphe in having irregular appendages but differing in having a single ascus rather than numerous asci.

S. macularis (Wallr.: Fr.) P. Magn., on *Geum canadense* Jacq., *Potentilla norvegica* L., *Rubus chamaemorus* L., *R. pubescens* Raf. (DAOM 184460). The most northerly collections are from Moosonee and N shore of Lake Nipigon. Hosts listed are all Rosaceae but other host families are attacked (Parmelee 1977). See also Fungi Canadenses No. 63.

S. mors - uvae (Schw.) Berk. & Curt., on *Ribes alpinum* L., Black Sturgeon Lake. Known only on *Ribes* (Saxifragaceae) in Ont. whereas the other mildew on Saxifragaceae (*S. fuliginea*) occurs on *Saxifraga* only.

Uncinula adunca (Wallr.: Fr.) Lév., on *Populus balsamifera* L. (DAOM 184477) and *P. tremuloides* Michx. (DAOM 184478). Both poplars are distributed widely across Canada as is the mildew. In Ontario it extends from

the southern most part north to Kapuskasing, Geraldton and Kenora. Willows also are attacked; *Salix bebbiana* Sarg., *S. discolor* Muhl., *S. humilis* Marsh. *S. myrtillifolia* Anderss. (DAOM 184481), *S. pedicellaris* Pursh, *S. rigida* Muhl. and *Salix* sp. Cleistothecial appendages are numerous (ca. 50-100), up to twice the diameter of the ascocarp in length and typically hooked at the apex.

U. circinata Cke. & Peck, on *Acer rubrum* L., *A. spicatum* Lam. (DAOM 184485); both maples occur mainly in eastern Canada. Red maple is limited to the Great Lakes -St. Lawrence Forest Zone, whereas mountain maple extends well into the boreal forest. The hooked appendages are numerous (ca. 100) and about the diam. of the ascocarp in length.

U. necator (Schw.) Burr., on *Parthenocissus quinquefolia* (L.) Planch.; from a planting in Kenora. Appendages are few (10-35), brown at the basal half and septate in contrast to those of the first two species in which they are hyaline and nonseptate.

PYRENOMYCETES

Asci are produced within a perithecium having a preformed ostiole or a beak through which ascospores are released. They are typically on foliage, twigs, branches or inflorescences and may be scattered or amassed.

Apiosporina collinsii (Schw.) Hohn, on *Amelanchier alnifolia* Nutt. Attawapiskat, Nipigon River, Black Sturgeon Lake, near Rainy River, Kenora. A conspicuous black subiculum supports a layer of perithecia covering leaf undersurfaces. Infected plants may exhibit witches brooms. See Fungi Canadenses No. 76. A *Cladosporium* anamorph precedes formation of the ascocarps.

A. morbosa (Schw.) v. Arx (= *Dibotryon m.* (Schw.) Theiss. & Syd.), on *Prunus pensylvanica* L.f., Moosonee (DAOM 184496), Kapuskasing, Geraldton and Kenora. Widespread across Canada on many species of plums and cherries; see Fungi Canadenses No. 84. The specimen from Geraldton (DAOM 184497) bears the Coelomycete epiparasite *Scopinella sphaerophila* (Peck) Malloch. See Fungi Canadenses No. 83.

Atopospora betulina (Fr.) Petrak (= *Phyllachora b.* (Fr.) Fckl., =*Dothidella b.* (Fr.)Sacc.), on *Betula glandulosa* Michx., [Fort George, Que.]; *B. papyrifera* Marsh., Pickle Lake (DAOM 184495) and Raith (48° 53'N 89° 55'W); *B. pumila* L., Moosoneee; See Fungi Canadenses No. 88.

Ceratocystis ulmi (Buism.) C. Moreau, on *Ulmus americana* L. was reported (FIDS 1978) for the first time from Thunder Bay Dist. for 1976. Elm was not affected west of Thunder Bay at that time. The fungus has since been reported from southern Manitoba (Campana & Stipes 1981). The infection was said to have spread from Minnesota.

Claviceps junci Adams, on *Juncus articulatus* L. (DAOM 184499) and *Juncus nodosus* L. (DAOM 184500), both from Geraldton area. Rarely collected in Canada - single collections on each host from Nova Scotia and Toronto, Ont. respectively and on additional hosts *J. brevicaudatus* (Engel.) Fern. and *J. brachycephalus* (Engel.) Buchenau from southern Ontario.

C. nigricans Tul., on *Eleocharis* sp., Opinnaga River 54° 12'N 82° 25'W, [Eastmain, Que.]

C. purpurea (Fr.) Tul., on *Agropyron repens* (L.) Beauv., Kapuskasing (DAOM 184502) and Black Sturgeon Lake, *A. trachycaulum* (L.) Malte, Moose River settlement (50° 48'N 81° 17'W); *Bromus innermis* Leyss., Poshkokagan River (49°N 89°W) and Black Sturgeon Lake; *Calamagrostis canadensis* (Michx.) Beauv., Black Sturgeon L. (first Ontario record); *Elymus innovatus* (Fr.) Tul., Attawapiskat (DAOM 184580), (first Canadian record); *E. mollis* L. Especially widespread on the first named host.

Coleroa rubicola (Ell. & Ev.) E. Muller & v. Arx, on *Rubus* sp., Temagami, Nipissing Dist. (extra limital); see Fungi Canadenses No. 92.

Cucurbitaria staphulae Dearn. ex Arnold & Russell, on *Populus* sp., Kenora area; teleomorph of *Macrophoma tumefaciens* (Coelomycete). Common in western Canada.

Gibbera kalmiae (Peck)Barr (= *Venturia k.*), on *Kalmia polifolia* Wang, [Fort George, Que.] causes conspicuous necrotic leaf spots; it is known widely in eastern Canada.

G. pulchella (Cke. & Peck) Petr. (= *Venturia pulchella* Cke. & Peck), on *Chamaedaphne calyculata* Moench, midway between Pickle Lake and Savant Lake (DAOM 184501). Reported by Bisby et al. (1938) from Ingolf and Kenora.

Guignardia bidwellii (Ell.) Viala & Ravaz, (anamorph *Phyllosticta ampelicida* (Coelomycete)) on *Parthenocissus quinquefolia* (L.) Planch, Minaki, Kenora (Bisby 1938 as *Phyllosticta viticola*).

Hypoxylon mammatum (Wahl.) Miller, on *Populus tremuloides* Michx., is represented in DAOM in southern Ont. to Temagami but reported from Cochrane, Kapuskasing, Geraldton and Kenora (FIDS for 1968) in moderate to high levels of infection. Hypoxylon canker is considered to be the most serious disease of aspen in the province (*op. cit.* for 1976). Other known hosts mainly in southern parts of Ontario include *Acer*, *Alnus*, *Corylus*, *Betula*, *Fagus* and *Salix*.

Metacoleroa dickiei (Berk. & Br.) Patrak (= *Venturia d.* (Berk. & Br.) Ces. & deNot.), on *Linnaea borealis* L., Sibley Pen., Kenora and from N.B. to B.C., See Fungi Canadenses No. 114.

Mycosphaerella colorata (Peck) Earle, on *Kalmia angustifolia* L., Mattagami River.

M. coptis (Schw.) House (st. conid. *Septoria*) on *Coptis groenlandica* (Oeder) Fern., causing conspicuous, large, necrotic leaf spots; near Black Sturgeon Lake (DAOM 184582).

M. effigurata (Schw.) House (st. sperm. *Piggotia fraxini* Berk. & Curt.) on *Fraxinus nigra* Marsh. 8 km SE Black Sturgeon Lake (DAOM 184581).

M. populicola G.E. Thompson (anamorph *Septoria p.* Peck), on *Populus balsamifera* L., Kenora. Conidia 45-85 x 2.5-3.5 um, 3-5 septa and considerably longer than *Septoria musiva*.

M. populorum G.E. Thompson (anamorph *Septoria musiva* Pk.), on *Populus balsamifera* L., Pigeon River in Thunder Bay Dist. (DAOM 184554), conidia 28-60 x 3.0-3.5 um, mainly 3-septate. This and the above species are widely distributed throughout Canada.

Nectria cinnabarina Tode ex Fr., (anamorph *Tuberculatia vulgaris* Tode, on *Prunus pensylvanica* L.f. near Kapuskasing (DAOM 184504a). A common and widely distributed parasite on twigs. In Canada known on *Acer*, *Alnus*, *Aralia*, *Betula*, *Quercus*, *Salix*, *Tilia*, *Ulmus* and other genera.

Phyllachora vulgata Theiss. & Syd. on *Muhlenbergia richardsonis* (Trin.) Rydb., junction Mattagami and Missinabi Rivers (DAOM 184584), Attawapiskat River 52°N 83°W (DAOM 184583); widespread in Canada, herbarium specimens most commonly on *M. mexicana* (L.) Trin. and M. racemosa (Michx.) BSP.

Physalospora miyabeana Fukushi on *Salix* sp., Pickle Lake (DAOM 184503), widspread in Canada.

DISCOMYCETES

Asci form in an apothecium which is sessile or stalked and cup-like or which opens by a preformed slit. Discomycetes are saprophytic or parasitic on vegetative parts of a host plant and usually follow a parasitic anamorph (conidial state).

Blumeriella jaapii (Rehm) v. Arx (= *Coccomyces prunophorae* Higgins) on *Prunus pensylvanica* L.f., causing a leaf spot and eventually a shot-hole symptom in its anamorph *Cylindrosporium prunophorae* (DAOM 184546, 184507). See treatment by Conners (1967).

Diplocarpon earlianum (Ell. & Ev.) Wolf, (anamorph *Marssonina fragariae*) on *Fragaria virginiana* Duchesne, Long Rapids on Mattagami River (DAOM 184550).

Diplocarpon mespili (Sorauer) Sutton (= *Diplocarpon maculatum* (Ait.) Jorst.) on *Sorbus* spp., teleomorph of *Entomosporium m.* Lév. q.v., a common leaf spot of mountain ash. On *Sorubus americana* Marsh., *S. decora* (Sarg.) Schneid., Abitibi Canyon (DAOM 184505), Junction Missinabi and Mattagami Rivers, Pickle Lake (DAOM 184509), Savant Lake, Kenora, [Great Whale River, Que.]

Gremmeniella abietina (Lagerb.) Morelet, on *Pinus banskiana* Lamb. and *P. resinosa* Ait. is general throughout northern Ontario. Pine plantations are especially susceptible to loss and high losses have been reported at Cochrane, Kapuskasing, Geraldton and Sioux Lookout (FIDS 1978). Specimens in DAOM support these records and include other hosts: *Picea glauca* (Moench) Voss from Dryden and *Pinus strobus* L. from Geraldton.

Hysteropezizella diminuens (Karst.) Nannf., on *Carex livida* (Wahl.) Willd., near Lake River (DAOM 184585). This is mainly an arctic species on dead culms and leaves of Poaceae, Cyperaceae and Juncaceae.

H. macrospora (Karst.) Nannf., on *Carex rostrata* Stokes, south of Winisk at 55°N (DAOM 178880), a new North American record (Pers. comm. R.A. Shoemaker).

Lophodermium juniperinum (Fr.) de Not., on *Juniperus communis* L. var. *depressa* Pursh, it is recorded from Thunder Bay Dist. (FIDS for 1973); on *J. hori zntalis* Moench, Slate Island in Lake Superior 48°N 86°W (DAOM 184586), with mature ascocarps on overwintered needles.

L. melaleucum (Fr.) deNot., on *Vaccinium vitis-idaea* L., Mattagami River 50° 27'N 81° 45'W., apparently limited to this host; ascospores are broader and paraphyses flexuous rather than hooked as in L. maculare (Fr.) de Not.; cf. Fungi Canadenses Nos. 195 and 196. *L. maculare* is reported on *Vaccinium* spp. other than the above from the N.W.T.

L. pinastri (Schrad. ex Hook.) Chev., on *Pinus banksiana* Lamb. and *P. resinosa* Ait., common in southern Ont. but no specimens in DAOM from northern Ontario. It is recorded on both hosts from Sioux Lookout, Geraldton and Fort Francis as trace to heavy infections (FIDS for 1970-72).

L. sphaerioides (Alb. & Schw. ex Fr.) Duby, on *Ledum groenlandicum* Oeder, Neys Prov. Park on Lake Superior 48° 45'N 86° 45'W. See Fungi Canadenses No. 197.

L. tumidum (Fr.) Rehm, on *Amelanchier* sp., White Otter River 49° 19'N 86° 01'W; as in other species treated here, the ascocarps mature on overwintered leaves.

Placuntium andromedae (Pers. ex Fr.) Hohnel (= *Rhytisma a.* (Pers.) Fr.), on *Andromeda glaucophylla* Link, near Moosonee, Fort Albany, Sandy Lake (DAOM 184591), and Black Sturgeon Lake; *Andromeda polifolia* L., Brant River near Cape Henrietta Maria (DAOM 184597), Shagum River 56°N 87°W. Not previously known in Ontario although Conners (1967) records it from Manitoba and Quebec.

Psudopeziza trifolii (Biv.-Bern.: Fr.) Fckl. f.sp. *medicaginis-sativae* Schneid., on *Medicago sativa* L., Kapuskasing (DAOM 184511); a general leaf-spotting of plants remaining in September in forage test plots at the Agr. Can. Experimental Farm.

Rhytisma punctatum (Pers.)Fr., on *Acer spicatum* Lam., most commonly represented in DAOM on this maple from eastern Canada; collected at Smooth Rock Falls, Abitibi Canyon (DAOM 184522), junction Mattagami and Missinabi Rivers, Kapuskasing, Geraldton, Pickle Lake (DAOM 194518) and Kenora. In southern parts of Ontario and other eastern provinces on *Acer negundo* L., *A. pensylvanicum* L., *A. saccharum* Marsh. and in B.C. on *A. macrophyllum* Pursh.

R. **salicinum** (Pers.) Fr. on *Salix arctica* Pall, Cape Henrietta Maria (DAOM 184593); *S. arctophila* Cockerell, Winisk (DAOM 184600); *S. cordata* Michx., Lake River; *S. discolor* Muhl., Kapuskasing; *S. eriocephala* Michx., Moosonee; *S. lucida* Muhl. (DAOM 184531), Moosonee and Timmins SW of Cochrane; *S. myrtillifolia* Anderss., Winisk (DAOM 184594); *S. pellita* Anderss., Lake River and Partridge River 51° 20'N 80° 24'W. Tar spot occurs on Salix spp. across Canada.

BASIDIOMYCETES

Haploid basidiospores (2-many) are formed externally on a specialized cell the basidium. In most of the fleshy basidiomycetes, single-celled basidia are produced in a vegetative structure the basidiocarp and bear basidiospores at their apex. In other groups such as rusts and smuts basidia are septate and bear basidiospores along the side of the basidium.

UREDINALES The rust fungi typically produce basidia from an overwintering spore - the teliospore. Rusts are obligate parasites of vascular plants and form localized or systemic pustules of spores on all above ground parts and occasionally cause noticeable malformations. Rusts are pleomorphic with up to five spore forms (pycniospores, aeciospores, urediniospores, teliospores and basidiospores), completing their life cycle on one host (autoecious) or two unrelated hosts (heteroecious). In accepting the fundamental importance of pycnia and telia in the nuclear cycle, Parmelee (1982) gives a summary of the order and its families.

Chrysomyxa arctostaphyli Diet., 0,I on needles of *Picea mariana* (Mill.) BSP., Long Lac near Geraldton, causes witches' brooms (one from Ignace (DAOM 184300) ca. 1 m diam.). Alternates to *Arctostaphylos uva-ursi* (L.) Spreng. II,III east of Kenora, Old Woman Bay Lake Superior ca. 47° 30'N, but distributed from the Maritime Provinces to B.C. Collections in DAOM are predominantly from western Canada. Also known on *Picea glauca* (Moench) Voss. Brooms on black spruce have been reported from near Sioux Lookout and White River (FIDS for 1970-72).

C. empetri Schroet. ex Cumm., II,III on *Empetrum nigrum* L. var. *hermaphroditum* Hagl., Attawapiskat River 53° 08'N 83° 18'W (DAOM 184602), [Rupert House, Fort George and Great Whale River, Que.]; the alternate states 0,I on *Picea glauca* (Moench) Voss, [Great Whale River, Que. and Churchill, Man.]. This rust is known from Nfld. to B.C. in Canada and occurs mainly on white spruce, less often on other species. This is the first confirmation of occurrence in Ontario.

C. ledi (Alb. & Schw.) deBary var. **cassandrae** (Peck & Clint.) Savile, 0,I on *Picea glauca* (Moench)Voss, Oba 49° N 84° W. Upsala in the region of Ignace, and near Atikoken. II,III on *Chamadaphne calyculata* (L.) Moench, 80 km south of Pickle Lake.

C. l. var. **groenlandici** Savile, 0,I on *Picea mariana* (Mill.) BSP. II,III on *Ledum groenlandicum* Oeder from near Michipicoten NW to Kenora. Savile (1955) recognized 5 varieties, all hypophyllous, on leaves of their respective II,III hosts. Unless there is conspicuous association of one such host with Picea, varietal segregation on the latter may not be possible.

C. ledicola (Peck) Lagerh., 0,I on *Picea glauca* (Moench) Voss, near Kapuskasing west to vicinity of Nipigon and Black Sturgeon Lake; II, III epiphyllous on *Ledum groenlandicum* Oeder, Ogoki, Cape Henrietta Maria (DAOM 184608), [Fort George, Que., Solomons Temple Island, James Bay 52° 50'N 79° 07'W, N.W.T.] west to Winisk, Big Trout Lake, Fort Severn (DAOM 184604). Widespread across Canada.

C. pirolata Wint., 0,I on *Picea glauca* (Moench)Voss, White River, systemic or partly so on cone scales. High levels of damage to the cone crop were reported from near Lake Nipigon in 1976 (FIDS 1978). Alternates in II, III states to systemic, hypophyllous infection of *Moneses uniflora* (L.) Gray, Michipicoten (DAOM 184610); *Pyrola elliptica* Nutt., Minaki; *P. virens* Schweigg. (= *P. chlorantha* Sw.) Missinabi River about 50°N, attawapickat River about 53°N. *Moneses* and *Pyrola* spp. may also become rusted with *Pucciniastrum pyrolae* Diet. ex Arth. which is localized with bullate uredinia on leaves.

C. weirii Jackson, III only on *Picea glauca* (Moench) Voss, localized on needles, Black Sturgeon Lake; on *P. mariana* (Mill.) BSP., Schreiber near Rossport. The only other Ont. collection in DAOM is from Nippissing Dist. Rust occurs sparingly across Canada and is known from limited specimens on red spruce [N.B. & N.S.] and on Engelman spruce [B.C.].

Coleosporium asterum (Diet.) Syd., 0,I on needles of *Pinus banksiana* Lamb., Temagami and W of Rossport (contiguous to Aster). II,III hypophyllous on *Aster ciliolatus* Lindl., Abitibi Canyon (DAOM 184304), near Kapuskasing; *A. cordifolius* L., Black Sturgeon Lake; *A. lateriflorus* (L.) Britt., Kapuskasing (DAOM 184306); *A. macrophyllus* L., 25 Km NW Cochrane (DAOM 184309), Abitibi Canyon, near Kapuskasing; near Rossport, Black Sturgeon Lake, Atikokan, Rainy River; *Solidago canadensis* L., Rainy River; *S. hispida* Muhl., near Kapuskasing, Winisk River 55°N (DAOM 184313); *S. juncea* Ait., SE Ignace; *S. multiradiata* Ait., [Great Whale River, Que.]; *S. uliginosa* Nutt., Thunder Bay. Throughout northern Ontario Jack pine is the main 0,I host whereas in southern Ont. the principal 0,I host is red pine (*P. resinosa* Ait.).

C. viburni Arth., 0,I on *Pinus banksiana* Lamb., Black Sturgeon Lake; II,III on *Viburnum rafinesquianum* Schultes var. *affine* (Bush) House, Little Dog Lake north of Thunder Bay. Not widely collected in northern Ontario, occurring more abundantly and on other species of *Viburnum* from Temagami southward and in Canada through southern Quebec to New Brunswick and Nova Scotia. Recorded by Bisby et al. (1938) only from the vicinity of Winnipeg.

Cronartium comandrae Peck, 0,I on branches and stems of *Pinus banksiana* Lamb. causing slight fusiform swellings. These perennial cankers have a length:width ratio of 4:1 (Ziller, 1974). Certainly found from northern Renfrew Co. southward with strong indication from the alternate states that rust on jack pine occurs north of 48° lat. II,III on *Geocaulon lividum* (Richards.) Fern., 80 Km south of Pickle Lake (DAOM 184314), [Great Whale River, Que.]; *Comandra richardsiana* Fern., near Dryden; *C. umbellata* (L.) Nutt., near Thunder Bay, near Kenora. Aeciospores may be blown north considerable distances but presumably the fungus cannot persist in areas far beyond the limit of *Pinus*.

C. comptoniae Arth., 0,I on *Pinus banksiana* Lamb., Iroquois Falls south of Cochrane. Recorded from Cochrane and Geraldton at moderate incidence and disease infection levels (FIDS 1978). Causes fusiform swellings on branches and, these perennial cankers have a length: width ratio of 4:1. Aecia produce ellipsoidal spores considerably shorter than the elongate pyriform aeciospores of *C. comandrae* (cf. Hiratsuka and Powell 1976 p. 32-33). II,III on *Myrica gale* L., near Kenora and Geraldton; also on *Comptonia peregrina* (L.) Coult., especially south of 48°N in Ontario (DAOM) but reported (FIDS for 1970) from Fort Francis.

C. ribicola J.C. Fischer, 0,I on *Pinus strobus* L., many specimens from Temagami southward but none north. White pine is found in Ontario to about 50°N and rust doubtless follows it (cf. FIDS for 1968 and 1976) II,III on *Ribes hirtellum* Michx., Fort Francis and on many other *Ribes* spp. southward in Ont. and eastern Canada. Widely distributed in Western Canada in the region of 5-needle pines.

Endocronartium harknessii (J.P. Moore) Y. Hiratsuka, 0,I,III on *Pinus banksiana* Lamb. Globoid galls form on branches and it is on these galls that the fungus produces repeating spores, similar in morphology to typical aeciospores of *Cronartium*, but, which function as teliospores to complete their abbreviated cycle on jack pine. Cochrane west through Nakina and Pickle Lake (DAOM 184315) to Kenora. FIDS for 1970-1976 record moderate and high damage levels on Jack pine in the Northwestern and North Central forest regions which include Cochrane, Geraldton, Sioux Lookout and Kenora. In Canada, this rust is established widely on Jack pine through to the Maritime provinces and on *Pinus contorta* Dougl. throughout its range in the west.

Gymnoconia peckiana (Howe) Trotter 0,I [III] on Rubus acaulis Michx., Moose Factory [and Loon Point, Que. 52° 05'N 78° 45'W]; on *Rubus pubescens* Raf., Moose Factory. See also Parmelee (1960) for distribution in southern Ont. and for comparison with *Kunkelia nitens* (Schw.) Arth.

Gymnosporangium clavipes (Cke. & Pk.) Cke. & Pk., 0,I on *Amelanchier alnifolia* Nutt., north shore Lake Superior to Kenora and adjacent Manitoba. In Ontario, the most northerly collection is from 53°N. III on *Juniperus communis* L. var. *depressa* Pursh, adjacent at above sites with the *Amelanchier* (Parmelee, 1964). Other hosts mainly in southern Ontario include 0,I: *Aronia*, *Cotoneaster*, *Crataegus*, *Malus*, *Sorbus* and III: *Juniperus horizontalis* L., *J. virginiana* L. See Fungi Canadenses No. 116.

G. clavariiforme (Pers.) DC., 0,I on *Amelanchier alnifolia* Nutt., Minaki and near Kenora. III on *Juniperus communis* L. var. *depressa* Pursh,

Minaki, [Great Whale River, Que.]. Distribution slightly more southern than for *G. clavipes* and host range more restricted. See Fungi Canadenses No. 115.

G. cornutum Arth. ex Kern, 0,I on *Sorbus americana* Marsh. (DAOM 184321), S., decora (Sarg.) Schneid. (DAOM 184617), *Sorbus* sp., Michipicoten N to Abitibi Canyon, [Piagochiwi River 54° 03'N 79° 02'W; Great Whale River, Que.], west around Lake Superior, Lake Nipigon, Savant Lake to Kenora and Big Trout Lake at 54°N. III on *Juniperus communis* L. var. *depressa* Pursh, just south of Michipicoten around north shore Lake Superior through Rossport to Minaki; 50 km NW Ignace. The dark brown pulvinate telia on the needles are inconspicuous in comparison to the bright orange telia on twigs and branches of the above two rust species, hence are collected infrequently. Alternate host associations at Abitibi Canyon and Savant Lake strongly indicate the presence of telia at those sites. See Fungi Canadenses No. 117.

G. nelsonii Arth. (= *G. corniculans* Kern), 0,I on *Amelanchier alnifolia* Nutt., *Amelanchier* sp., Abitibi Canyon and Attawapiskat (DAOM 184621), north shore of Lake Superior to Kenora. III on globoid galls on *Juniperus horizontalis* L., Winisk River 54° 52'N 85° 45'W (DAOM 184620). Extensive colonies of juniper extend along Lake Huron, Manitoulin Island where the rust abounds; elsewhere rust is widely scattered along with the widely scattered juniper. In Western Canada *G. nelsonii* also attacks *J. scopulorum* Sarg. See Fungi Canadenses No. 138.

Hyalopsora aspidiotus Magn., on *Gymnocarpium dryopteris* (L.) Newm. var. *dryopteris*. Abundant at Lake Timagami, and to be sought in our area. Host reaches Moosonee.

H. cheilanthis (Peck) Arth., 0,I not known, expected on *Abies*. II, III on *Cryptogramma stelleri* (Gmel.) Prantl, Michipicoten (DAOM 184622), Ouimet Canyon SW of Nipigon. One collection by Macoun in 1884 bears the location only as L. Superior. Known also in Bruce Co. and from a few sites in Cté. Gaspé and Cté. Bonaventure, Que.

H. polypodii (Pers.) Magn., 0,I not known. II III on *Cystopteris bulbifera* (L.) Bernh., Heron Bay south of Marathon and only one other site in Ontario in Halton Co. More widely collected on *C. fragilis* (L.) Bernh. from Temagami south.

Melampsora abieti-capraearum Tubeuf, II III on Salix cordata Michx. (DAOM 184623), Lake River. Current tendency is to include this species in *M. epitea s. lat.* Spore measurements of this specimen are intermediate between the two.

M. epitea Thum., 0,I on Pinaceae, not known with certainty in northern Ontario. II, III on *Salix* spp.: *S. adenophylla* Hook., [Rupert House, Que.]; *S. arctophila* Cock., Winisk (DAOM 184625); *S. cordata* Michx., near Moose Factory; *S. interior* Rowlee, junction Moose and Abitibi Rivers; *S. lucida* Muhl., Black Sturgeon Lake; *S. pellita* Anders. (DAOM 184325), Timmins, near Moose Factory, Attawapiskat; *S. reticulata* L., Winisk. These collections extend the northern distribution in Ontario by about 500 km.

M. Lini (Pers.) Lev., 0,I,II,III on *Linum lepagei* Boivin Attawapiskat, [Fort Churchill, Man.]; *L. usitatissimum* L., Kapuskasing and especially in the western provinces along with *L. lewisii* Pursh. A summary of rust resistant flax cultivars in Canada and losses experienced in susceptible varieties was provided by Conners (1967).

M. medusae Thum., 0,I on *Larix* spp., established by culture methods but no specimens from northern Ontario. II,III on *Populus tremuloides* Michx., near Kapuskasing (DAOM 184330) and well into southern Ont.

M. paradoxa Diet. & Holw., 0,I on *Larix* spp., as established by culture (Ziller 1974), but not known with certainty in nature in Ontario; II,III on *Salix amygdaloides* Anderss., near Hearst (DAOM 184331). On *Salix* sp., Black Sturgeon Lake causing conspicuous cankers on twigs 11 mm diam. or less. Urediniospore characters match those from descriptions well but no paraphyses were seen. This rust is fairly common on leaves of willow but this is the first report of it attacking twigs. This species is within the *M. epitea* complex.

Melampsorella caryophyllacearum Schroet., 0,I on *Abies balsamea* (L.) Mill., Moose Factory, Kapuskasing, Hearst (DAOM 184328), Geraldton (DAOM 184334), Nipigon, Black Sturgeon Lake. II,III on *Cerastium alpinum* L. [Great Whale River, Que.]; *Stellaria graminea* L., Heron Bay; *S. monantha* Hult., [Great Whale River, Que.]. The fungus causes the formation of dense witches' brooms on balsam fir and localized pustules on leaves of Caryophyllaceae, especially on *Cerastium arvense* L. elsewhere in Canada.

Melampsoridium betulinum (Pers.) Kleb., 0,I on *Larix laricina* (Du Roi) Koch, but not known in Ontario; II,III on *Betula glandulosa* Michx., [Vieux Comptior 52° 37'N 78° 42' W. Que.] and locally in southern Ont.

Milesia fructuosa Faull, 0,I on *Abies balsamea* (L.) Mill., on current year needles, Fort Albany (DAOM 184628), alternating in II,III states to fronds of *Dryopteris* spp. as determined by inoculation trials in the Temagami region.

Nyssopsora clavellosa (Berk.) Arth., III only, epiphyllous on *Aralia nudicaulis* L., Kapuskasing (DAOM 184337) west through Nipigon to Kenora. The earliest collection is one by Macoun from Nipigon dated 1884. See Fungi Canadenses No. 221.

Phragmidium americanum (Peck) Diet., 0,I,II,III on *Rosa acicularis* Lindl., Smooth Rock Falls, Abitibi Canyon, Kapuskasing, Geraldton, Nakina (DAOM 184339), Pickle Lake (DAOM 184347); on *Rosa* sp., near Geraldton, Black Sturgeon Lake, Fort Albany. Previously collected only to about 48°N.

P. andersoni Shear, 0,I,II,III on *Potentilla fruticosa* L., near Rossport, near Geraldton, Hudson Bay coast 56°N 87°W (DAOM 184629). The collection from the last site extends the distribution north by 700 km.

P. arcticum Lagerh. ex Liro 0 not known; I,II,III on *Rubus acaulis* Michx., [Great Whale River, Que.]. See Fungi Canadenses No. 79.

P. fusiforme Schroet. var. **novi-boreale** Savile 0,I,II,III on *Rosa acicularis* Lindl., East shore Lake Nipigon, Black Sturgeon Lake, Sibley Pen., near Hearst, Fawn River 55°N 88°W, near Winisk 55°N 85°W (DAOM 184634); on *Rosa blanda* Ait., Ogoki (DAOM 184352), near Moose Factory. The Winisk collections extend the known distribution northward in Ontario by 400 km. *P.f.* var. *fusiforme* is European and morphological comparison is presented in Fungi Canadenses No. 54.

P. ivesiae Syd., I,II,III on *Potentilla recta* L., Sibley Pen., Gogama at 47° 41'N 81° 44'W (DAOM 184635). Common in southern Ont. and western Canada. A comparison of this rust with related species in North America is given by Savile (1976) including a discussion of its spread from the west eastward into Ontario and New York. Unlike other *Phragmidium* species, this and its relatives (*op. cit.*) release teliospores by a fracturing of the non-hygroscopic, ± cylindrical pedicel just below attachment to the spore.

P. occidentale Arth., 0,I,II,III on *Rubus parviflorus* Nutt., Sibley Pen. Specimens in DAOM are mainly from B.C. east to Lake Superior; on *R. odoratus* L., they are from eastern Ontario and southwestern Quebec. See Fungi Canadensis No. 80.

P. rubi-idaei (DC.) Karst., 0,I,II,III on *Rubus idaeus* L. var. *aculeatissimus* Regel & Tiling, near Smooth Rock Falls (DAOM 184354), Kapuskasing, Hearst; *R.i.* var. *strigosus* (Michx.) Maxim. [Ft. George, Great Whale River, Que.].

P. speciosum (Fr.) Cooke, 0,I,III on *Rosa acicularis* Lindl., Dryden, Kenora, Minaki. Telia cause black, unsightly, fusiform swellings of canes, petioles or any vascular tissue. The rust is more abundant in southern Ontario.

Puccinia angustata Peck 0,I on *Lycopus uniflorus* Michx., near White River townsite 48° 18'N 84° 59'W, Wabimeig Lake 51° 28'N 85° 36'W (DAOM 184358). II III on *Scirpus atrocinctus* Fern. (overwintered III), near White River, adjacent rusted *Lycopus* (above), St. Ignace Island in Lake Superior west of Rossport; *S. atrovirens* Willd., Rainy River; *S. microcarpus*

Presl., Rossport (DAOM 184636); *S. rubrotinctus* Fern., Black Sturgeon Lake. Other species of *Lycopus*, *Mentha* and *Scirpus* bear this rust especially in southern Ontario.

P. arenariae (Schum.) Wint., III only on *Arenaria laterifolia* L., junction Fawn and Otter Rivers 54° 20'N 88° 32'W (DAOM 184638); *A. peploides* L., [Great Whale River, Que.]; *Stellaria longipes* Goldie, Polar Bear Prov. Park 54° 52'N 83° 25'W (DAOM 184639); *S. calycantha* (Led.) Bongard, [Great Whale River, Que.]; *S. monantha* Hult., [Great Whale River, Que.]. Based on the specimens from Gt. Whale River, Parmelee (1960) forecast the presence of this rust in northern Ontario and the above records extend its distribution northward in Ont. by some 700 km.

P. asteris Duby, III only on *Aster cordifolius* L., Kenora; *A. laevis* L., Minaki; *A. macrophyllus* L., Smooth Rock Falls, Kapuskasing (DAOM 184359), Missinabi River 50°N 83°W, White River 48° 35'N 85° 20'W, Rossport, Sibley Pen., Atikoken, Rainy River, Kenora; *A. simplex* Willd., near Kapuskasing (DAOM 184361), Ft. Francis. Rust is distributed throughout southern Ontario in deciduous forest and mixed forest zones.

P. bistortae (Str.) DC., 0,I on *Cicuta* sp. and *Sium sauve* Walt., Piskwamisk 51° 42'N west coast James Bay; II,III *Polygonum viviparum* L. [Great Whale River, Que.]. Previously not known in the province but the presence of this rust was expected (Parmelee 1960).

P. bolleyana Sacc., 0,I on *Sambucus pubens* Muchx. Just south of 48°N at Agawa Bay Lake Superior and at Chapleau about 110 km east of Michipicoten; rust infection causes hypertrophy and malformation of vascular tissue on leaves and petioles. II III on *Carex tribuloides* Wahlenb., Mammamattawa

(DAOM 184362). In southern Ontario other *Carex* spp. support this rust. *Puccinia bolleyana* was mistakenly reported on *Larix* (FIDS for 1973) from Thunder Bay Dist. The report referred to a high level of needle rust on shore line trees. The report may indeed apply to a *Melampsora* (*q. v.*) two species of which are known to alternate between *Larix* and either *Populus* or *Salix*.

P. calthae Lk., 0,I,II,III on *Caltha palustris* L., Thunder Bay, Otter Cove south of Nipigon. Separation of *P. calthicola* Schroet. on the same host is dependent on II,III spore characters: urediniospore pores superequatorial and teliospore wall smooth vs. urediniospore pores ± equatorial and teliospore wall minutely verrucose respectively.

P. caricina DC., 0,I on *Ribes glandulosum* Grauer, [Richmond Gulf 56° 05'N 76° 20' W, Que.]; *Ribes hirtellum* Michx., [Vieux Comptoir, Que.]; *R. hudsonianum* Richards, Mattagami River 56° 08'N 82° 14' W (DAOM 184643), Ft. Albany, Raith 48° 53'N 89° 55'W; *R. triste* Pall., Moosonee; *Ribes* sp., Black Sturgeon Lake. II,III on *Carex bigelowii* Torr., [Great Whale River, Que.]; *C. lanuginosa* Michx., near Geraldton (DAOM 184363); *C. pedunculata* Muhl., Kakagi Lake 49° 10'N 93° 49'W. (DAOM 184637), near Cochrane. Widely distributed throughout Ontario and Canada; these records support an earlier premise (Parmelee 1960) that this complex rust would probably extend to Hudson Bay in Ontario. Authors vary in their treatment of the complex, some recognize specific or varietal segregates, Arthur (1934, p. 207) treats five varieties one of which is here treated under specific status viz. *P. uniporula*).

P. circaeae Pers., III only on *Circaea alpina* L., near Nipigon, Sibley Pen. (DAOM 184644), and throughout southern Ontario.

P. cnici Mart., 0,I,II,III on *Cirsium vulgare* (Savi.) Tenore, St. Ignace Island south of Nipigon. This and other species of *Puccinia* on Asteraceae Cardueae: *Cirsium* have been studied by Savile (1970). He employs urediniospore wall sculpturing and pore number and position along with similar teliospore characters to separate the rusts attacking Cardueae.

P. comandrae Peck, III only on *Geocaulon lividum* (Richards.) Fern. (*Comandra l.* Richards.), Heron Bay near Marathon, S of Pickle Lake (DAOM 184366), *Comandra richardsiana* Fern. Lake Nipigon (DAOM 184365).

P. conglomerata (str.) Rohling, III only on *Petasites nivalis* Greene, Lake River, [Great Whale River, Que.]; *P. palmatus* (Ait.) Gray, [Opinaca River, 52° 33'N 76° 41'W and Great Whale River, Que.], White Lake Prov. Park Thunder Bay Dist., E of Lake Nipigon Coll. J. Macoun in 1884,Sibley Pen.; *P. sagittatus* (Pursh) Gray, [Great Whale River, Que.]; *Petasites* sp., Lake River. See Fungi Canadenses No. 110.

P. coronata Cda., 0,I on *Rhamnus alnifolia* L'her, near Timmins, Moosonee-Moose Factory, Ft. Albany, Polar Bear Prov. Park ca. 54°N 83°W (DAOM 184648), Sutton Lake (DAOM 184645), Winisk River ca. 54°N 87°W, near Kapuskasing, Black Sturgeon Lake, south of Sioux Lookout. II, III on *Avena sativa* L., Kapuskasing; *Calamagrostis canadensis* (Michx.) Beauv., Moosonee, Ft. Albany. Good alternate host association and all rust states were in evidence at the Moosonee sites. Aecia are hypophyllous in very compact circular groups. These records extend the distribution in Ontario by 600 km. northward.

P. dioicae P. Magn., 0,I on *Aster macrophyllus* L., near White River; *Oenothera* sp., Kenora; *Solidago purshii* Porter, near Moosonee (DAOM

184368). II,III on *Carex aenea* Fern. [Opinaca River 52° 34'N 76° 41'W, Que.]; *Carex disperma* Dew., Big Trout Lake (DAOM 184658); *C. houghtonii* Torr., Black Sturgeon Lake; *C. lasiocarpa* Ehrh., Black Sturgeon Lake; *C. papupercula* Michx., Thunder Bay, Missinabi River 50° 10'N 83° 01'W, near Moosonee, Sandy Lake. (DAOM 184652), *C. scirpoidea* Michx., Albany River 51° 13'N 84° 22'W, Jig Saw Island 54° 52'N 85° 34'W; *C. scoparia* Schkuhr near White River and associated with the above *Aster*, Thunder Bay; *C. stipitata* Willd., near Kapuskasing; *C. tribuloides* Wahl., Mammamattawa (DAOM 184656). Varietal segregation was assigned by Arthur (1934) sub. *P. extensicola*. Most of these segregates have aecial hosts in the Asteraceae and are considered as rightfully assigned to this complex but those on other host families (*e.g.* Oenothera) may belong elsewhere. A cosmopolitan species.

P. drabae Rud. III only on *Draba arabisans* Michx., Leadman Island in Lake Superior 48° 41'N 86° 56'W, Trowbridge Island in Lake Superior 48° 18'N 88° 52'W. This rust and others on Brassicaceae were described by Savile (1974) with full distribution citations for North America. Telia are systemic. *P. drabicola* Savile which also infects this host forms localized telia and the teliospores are morphologically separable. Both species are primarily arctic-alpine in habitat but the latter is not known in Ontario.

P. epilobii DC. ssp. **palustris** Urban, III only on *Epilobium leptophyllum* Raf., Wabimeig Lake northeast of Ogoki (DAOM 184370) (a first report on this host); *E. palustre* L., [Long Island 54° 36'N east coast James Bay, Que.], near Thunder Bay. Savile (1962) recorded the Quebec specimens on *E. palustre* plus a few others from Newfoundland and B.C. The specimen from Ontario was found from scrutiny of botanical specimens in CAN.

P. gigantea Karst. III only on *Epilobium angustifolium* L., [Fort George, Que.]. Limited to fireweed and appearing as conspicuous black pustules nearly always associated with vascular tissue on leaves, petioles, stems.

P. graminis Pers. 0,I on *Berberis vulgaris* L., rust unknown on barberry in northern Ontario although the host has been found at Long Lac near Geraldton and at Thunder Bay (DAO). In southern Ontario barberry has often been the source of localized rust outbreaks on cereals. II,III on *Avena sativa* L., Kapuskasing; *Hordeum vulgare* L., Kapuskasing; *Phleum pratense* L., Minaki, Kapuskasing; *Triticum aestivum* L., Kapuskasing. Stem rust is known to attack many other grasses in southern Ontario (Parmelee 1960). Summaries of stem rust outbreaks on many of them, especially on the above cereals, are available in Conners (1967). Urban (1967) recognized three morphologically distinct entities in *Puccinia graminis*: *P. graminis* Pers. ssp. *graminis* contains two varieties: *P.g.* ssp. *graminis* var. *graminis* (including wheat stem rust), and *P.g.* ssp. *graminis* var. *stakmanii* Guyot, Massenot & Saccas ex Urban (including barley and oat stem rusts). *P. graminis* spp. *graminicola* Urban infects many festucoid grasses, including *Phleum*, but not cereals. The host ranges of these three taxa are further discussed by Savile (in press).

P. grindeliae Peck, 0,III on *Solidago multiradiata* Ait., [Great Whale River, Que]. Two collections (Que.) are disjunct from the wide, mainly southern, range of this rust which extends from Texas north to Manitoba and Washington A comparable distribution to the correlated full-cycled species *P. stipae* Arth.

P. haleniae Arth. & Holw., III only on *Halenia deflexa* (Sm.) Griseb., Thunder Lake NE Fort Francis; *Gentiana* sp., Minaki (Bisby et al, 1938).

P. helianthi Schw., 0,I,II,III on *Helianthus annuus* L., Kapuskasing; also *H. maximilliani* Schrad., Temagami. Widespread in southern Ontario and southward. A circumglobal species. See Fungi Canadenses No. 95.

P. heucherae (Schw.) Diet., III only on *Mitella nuda* L., near Kapuskasing, Mattagami River near Smoky Falls (DAOM 184371), near Moose Factory, Ft. Albany, [Great Whale River, Que.]. Microcyclic Puccinias on Saxifragaceae were revised taxonomically by Savile (1973) who recognized 7 varieties in this species. Specimens from above sites are *P. h.* var. *minor* Savile.

P. Hieracii (Rohl.) Mart., 0,II,II,III on *Hieracium candense* L., Michipicoten, near Thunder Bay, Fort Francis, Kenora, Pickle Lake (DAOM 184374), Attawapiskat, [Great Whale River, Que.]; *Hieracium kalmii* L., Black Sturgeon Lake; *Hieracium umbellatum* L., Nipigon, Winsk River 55°N 82°W (DAOM 184666); *Taraxacum officinale* Weber, Kapuskasing, Abitibi Canyon, Geraldton, Moosonee-Moose Factory (DAOM 184376), Ft. Francis, Kenora. Parmelee and Savile (1981) recognize two other species of *Puccinia* on *Hieracium*. *Puccinia columbiense* Ell. & Ev. and *P. fraseri* Arth. possess telia only with smooth-walled spores but neither are known in northern Ontario. *Puccinia variabilis* Grev., also on *Taraxacum* sp., is of localized occurrence in Canada but is unknown in Ontario to date. Its life cycle (0,I,II,III) and completely echinulate II spores with equatorial rather than superequatorial pores are characters useful in its identification. The finds on *Hieracium kalmii* and *H. umbellatum* document new hosts for the fungus

and the collections from Winisk significantly extend northward the known range of the rust in Ontario.

P. holboellii (Hornem) Rostrup (= P. thlaspeos Schub. in part), 0,III systemic on *Arabis arenicola* (Rich.) Gelert, Cape Henrietta Maria, [Great Whale River, Que.]; *A. divaricata* A. Nels., Thunder Bay; *A. lyrata* L., [Richmond Gulf 56° 10'N 76° 50'W, Que.]; *Draba incana* L., [Vieux Comptoir, Que.]. In the Arctic Islands widespread on *Erysimum pallasii* (Pursh) Fern. The Canadian distribution of this rust and the critical features differentiating it from *Puccinia thlaspeos* which occurs on *Arabis* and *Thlaspi* are given in Fungi Canadenses No. 47.

P. karelica Tranz. ssp. **laurentiana** Savile, 0,I on *Trientalis borealis* Raf., Moosonee. II III on *Carex magellanica* Lam., Moosonee, Rainy River, [Rupert House, Que.] *C. scirpoidea* Michx., Jigsaw Island (DAOM 184385), Winisk River. This subspecies is limited to eastern Canada while *P.k.* ssp. *Karelica* is recorded only from the Queen Charlotte Islands, B.C. Illustrations and distribution are given in Fungi Canadenses No. 206. The Jigsaw Island material extends the known range northward by 500 km and represents new host species.

P. laschii Lagerh. var. **laschii** (= *P. cirsii* Lasch, = *P. calcitrapae* auct.), 0,II,II,III, on *Cirsium muticum* Michx., Black Sturgeon Lake, Raith 48° 25'N 89° 59'W (DAOM 184668), Rainy River. Savile (1970) indicated that the fungus ranges from coast to coast in North America but is commoner in the west.

P. linkii Kotzsch, III only on *Viburnum edule* (Michx.) Raf., Nipigon, Moosonee. The latter site extends the known distribution in Ontario northward by 250 km.

P. malvacearum Bert. ex Mont., III only on *Althaea rosea* (L.) Cav., Kenora. The distribution of this rust is recorded (Fungi Canadenses No. 171) from all provinces except Newfoundland. In southern Ontario, it is known on other species of *Althaea* and on *Malva*.

P. mcclatchieana Diet. & Holw., 0,I not known; II III on *Scirpus rubrotinctus* Fern., Attawapiskat. The urediniospores have 3 equatorial pores and completely echinulate walls, which facilitate taxonomic separation from *P. angustata* (also on *S. rubrotinctus*) which has 2 moderately superequatorial pores and walls echinulate with noticeable tonsure around or below pores.

P. menthae Pers. 0,I,II,III on *Mentha arvensis* L., Black Sturgeon Lake, near Moosonee (DAOM 184388). On other mints southward, along with *Satureja* spp. and *Lycopus* spp. All these hosts also take the aecial state of *Puccinia angustata*. The latter is distinguished by its cupulate aecia and aeciospores with fine and coarse wall verrucae as opposed to bullate aecia and aeciospores with uniformly coarse verrucae in *P. menthae*. *P. menthae* was previously known as far north as Nipissing District.

P. mesomejalis Berk. & Curt. ex Peck, III only on *Clintonia borealis* (Ait.) Raf., Michipicoten, White River 48° 15'N 84° 35'W, near Marathon, Black Sturgeon Lake, Thunder Bay, near Dryden, Minaki, Pickle Lake (DAOM 184391).

P. millefolii Fckl., III only on *Achillea millefolium* L., Raith 48° 50'N 89° 55'W (DAOM 184670), [Great Whale River, Fort Chimo, Que.]. The Quebec specimens suggest that this rust will be found much farther north than Raith in Ontario. In Europe, this rust species has been treated synonomously with *P. cnici-oleracei* Pers. ex Desm. In North America, Cummins (1978)

followed this action but Parmelee and Savile (1981) retained some of the synonymized taxa at the species level *e.g. P. columbiense* Ell. & Ev. and *P. asteris* Duby (above).

P. minussensis Thum., 0,I,II,III on *Lactuca pulchella* (Pursh) DC., Mammamattawa (DAOM 184392), Rainy River. Systemic in 0,I states causing the host to be stunted and distorted but secondary infections are localized. In Canada rust ranges from Mammamattawa through Rainy River District northwest to B.C. and Mackenzie Dist., N.W.T. Mammamattawa is over 300 km. north of Rainy River and extends the known distribution in Ontario over 600 km east (Parmelee & Savile 1981).

P. orbicula Peck & Clint. Variable cycle: 0,I,II,III or 0,II,II,III or 0,III on *Prenanthes alba* L., near Moosonee. This rust parasitizes other species of *Prenanthes* from Nfld. to Sask. and in northeastern United States reflecting the pattern found in Eastern Canada. Previously known from Parry Sound Dist. southward in Ontario. See Parmelee and Savile (1981) for extralimital species of *Puccinia* on *Prenanthes*.

P. pazschkei Diet. var. **oppositifoliae** Savile III only on *Saxifraga oppositifolia* [Great Whale River, Que.]. Savile (1973) recognized 7 varieties of this species based on spore characters. The host is known from Cape Jones, Que. ca. 54° 20'N, across James Bay from Cape Henrietta Maria, Ont. and from Churchill, Man. Rust might be found in Polar Bear Prov. Park where good-size colonies of the host occur. Telia are not easily noticed.

P. pimpinellae (Str.) Mart., 0,I,II,III on *Osmorhiza claytoni* (Michx.) Clarke, Mammamattawa (DAOM 184393). This rust is widely scattered in southern Ontario to Algoma Dist. (Parmelee 1960). This collection extends the distribution some 200 km northward.

P. poae-nemoralis Otth. (= *P. brachypodii* Otth. var. *poae-nemoralis* (Otth.) Cumm. & Greene) [0,I] unknown in North America, Cummins 1971 reports it on *Berberis* from India. II,III on *Agrostis borealis* Hartm., [Great Whale River, Que.]; *Poa pratensis* L., Long Lac near Geraldton, Keewatin; *Trisetum spicatum* (L.) Richt., [Great Whale River, Que.]. Cummins (*op. cit.*) indicated that the fungus exists without the aecial host and this is apparently true in North America. Abundant paraphyses in the uredinia aid in identification of this species. It was known previously to 47°N and with the records herein its range extension north in Ontario is *ca.* 400 km., but it also occurs far north in the arctic.

P. polygoni-amphibii Pers., 0,I on *Geranium* spp., in southern Ontario only; II,III on *Polygonum amphibium* L., Michipicoten (DAOM 184669), near Geraldton, junction Missinabi and Mattagami Rivers. This is a very common rust on *Polygonum* spp. especially on the species given. These collections extend the distribution northward in Ontario by 500 km.

P. porphyrogenita Curt., III only on *Cornus canadensis* L., Mickwam Lake 49° 30'N 80° 08'W, Kapuskasing (DAOM 184397), Pagwachuan 49° 39'N 86° 16'W, near Hearst, Lake Nipigon, Black Sturgeon Lake, Kenora, Pickle Lake (DAOM 184396).

P. praegracilis Arth. var. **connersii** Savile, pycnia lacking, aecia on *Habenaria dilatata* (Pursh) Hook., [Great Whale River, Que.]; II,III *Vahlodea atropurpurea* (Wahl.) Fr. (= *Deschampsia a.* (Wahl.) Steele). Short digitations on the apices of III spores are useful in diagnosis, [Great Whale River, Que. and B.C.].

P. pulsatillae Kalchb., III only on *Anemone parviflora* Michx., [Great Whale River, Que.]. Rare in Quebec. Parmelee (1960) expected this rust to occur in northern Ontario and it is yet to be found; common in alpine alta., B.C. and N.W.T.; found also in Nfld. and Labrador. See Fungi Canadenses No. 254 (in press).

P. punctata Lk. var. **punctata** [0,I]II, III on *Galium labradoricum* Wieg., Moosonee. Urediniospores have two superequatorial germ pores. Previous northern report is from Algoma Dist.

P. punctata Lk. var. **troglodytes** (Lindr.) Arth., 0,I unknown; II III on *Galium triflorum* Michx., near Kapuskasing, Abitibi Canyon (DAOM 184400). Urediniospores have two equatorial germ pores. Distribution was known previously to Lanark Co.

P. punctiformis (Str.) Rohl. (= P. obtegens Tuls.), 0,II'[1],II[2],III, systemic (or localized secondary infections) on *Circium arvense* (L.) Scop., Nipigon, near Thunder Bay. Distributed throughout Canada and host restricted this rust was first collected in Ontario (Belleville) by J. Macoun in 1895.

P. recondita Rob. ex Desm. *s. lat.*, 0,I localized on *Anemone multifida* Poir., James Bay 51° 10'N 80° 40'W (DAOM 184673), Nipigon; *Anemone* sp., Thunder Bay; *Clematis verticillaris* DC., Mammamattawa; *Ranunculus arborvitis* L., Black Sturgeon Lake (DAOM 184674); *R. cymbalaria* L., Albany River at James Bay; *Thalictrum confine* Fern., Ft. Albany (DAOM 184676). II,III on *Agropyron trachycaulon* (Lk.) Malte var. *novae-angliae* (Scribn.) Fern., junction Missinabi and Mattagami Rivers (DAOM 184672). This circumglobal rust is treated as a complex of species by Cummins (1971) wherein 51 synonyms are listed with the suggestion that segments of this rust

population exist regionally and probably will be treated separately. *Puccinia triticina* (Frikss.) and *P. impatiens-elymi* Arth. in Kleb., both of southern Ontario may serve as examples. Among the 37 grass host genera listed (*op. cit.*) are such cereals as wheat, rye, oats and barley and many wild grasses.

P. ribis DC., III only on *Ribes triste* Pall., near Mammamattawa (DAOM 184677), Moose Factory.

P. rubefaciens Johans., III only on *Galium boreale* L. (= *Galium septentrionalis* R. & S.), Minaki, Keewatin, Kenora, Sioux Narrows all bordering Lake of the Woods. It is not known elsewhere in Ontario. Although host collections in Ontario (DAO) extend from Attawapiskat and Moose Factory throughout southern Ontario, the rust is distributed westward in Canada from Lake of the Woods.

P. saxifragae Schlecht. var. **curtipes** (Howe) Diet. (= P. heucherae (Schw.) Diet. var. *saxifragae* (Schlecht.)Savile). III only on *Saxifraga rivularis* L., [Great Whale River,Que.]; *Saxifraga richardsiana* R. Br., Kenora; *S. virginiensis* Michx., Sibley Pen. This is mainly a rust of arid to mesic sites in contrast to the distribution of its hosts.

P. saxifragae Schlecht. var. **heucherarum** Savile (= *P. heucherae* (Schw.) Diet. var. *saxifragae* (Schlecht.) Savile), III only on *Heuchera richardsiana* R.Br., Kenora. A rust of cool, moist alpine sites (*cf.* Savile 1973 p. 2358).

P. sorghi Schw., II,III on *Zea mays* L., Kapuskasing; specimens taken at the Agr. Can. Experimental Farm in 1926 and 1935. The aecial host is known to be *Oxalis* spp.; two specimens extant in DAOM were obtained from artificial inoculation.

P. uniporula Orton, 0,I on *Ribes* spp. II,III on *Carex castanea* Wahlenb., Black Sturgeon Lake (DAOM 184679); *C. gracillima* Schw., Thunder Bay. This species is known widely in southern Ontario on *C. arctata* Boott and *C. debilis* Michx. Urediniospores bear one germ pore near the hilum.

P. violae (Schum.) DC. ssp. **americana** Savile, 0,I,II,III on *Viola adunca* Sm., Sutton Lake (DAOM 184680), [Great Whale River, Que.]; *V. incognita* Brainerd, Schreiber 48° 45'N 87° 15'W; *V. mackloskeyi* Lloyd ssp. *pallens* (Banks) Baker, Thunder Bay Dist. 48° 03'N 89° 34'W, Big Trout Lake (DAOM 184682); *V. pensylvanica* Michx., var. *leiocarpa* (Fern. & Weig.) Fern, junction Mattagami and Missinabi Rivers; *V. renifolia* Gray, near Smooth Rock Falls, Abitibi Canyon (DAOM 184405); *Viola* sp., Black Sturgeon Lake. Canadian collections of rust on *Viola* spp. were placed in this subspecies by Savile (see Fungi Canadenses No. 75) because of larger spores. Comparable specimens from Europe were assigned to ssp. *violae*.

Pucciniastrum agrimoniae (Diet.) Tranz., 0,I not known, possibly on *Tsuga*; II,III on *Agrimonia gryposepala* Wallr., Minaki. Distribution extends from southern Ontario.

P. americanum (Farl.) Arth., 0,I on current year needles of *Picea glauca* (Moench) Voss; II, III on *Rubus idaeus* L. var. *aculeatissimus* Regel & Tiling near Kapuskasing (DAOM 184407). Conners (1967) remarks on the occurrence of adjacent, alternate hosts in New Brunswick both bearing rust. Uredinial peridia have knobbed ostiolar cells.

P. arcticum Tranz., 0,I on current year needles of *Picea glauca* (Moench) Voss; II,III on *Rubus pubescens* Raf., near Marathon, Fort Albany.

Darker (1929) proved the life cycles of both *P. americanum* and *P. arcticum* from culture work done at Temagami. Ostiolar cells of the uredinial peridia are not knobbed. This rust was previously known as far north in Ontario as Nipissing Dist.

P. epilobii Otth., 0,I on *Abies balsamea* (L.) Mill. is reported from Kapuskasing, Geraldton, Fort Frances and Thunder Bay regions (FIDS for 1970-73) but there are no DAOM specimens at hand; II,III on Epilobium *angustifolium* L., Smooth Rock Falls, near Kapuskasing, junction Mattagami and Missinabi Rivers (DAOM 184408), Nakina, Pickle Lake (DAOM 184411), near Rainy River, Minaki. Darker annotated one of his collections from the Temagami area (DAOM 84210) that rusts on *E. angustifolium* and *E. adenocaulon* Hausskn. were not cross-inoculable. These findings were supported by Savile (1962) who showed differences in all spore states and retained them as separate species, *P. epilobii* and *P. pustulatum*.

P. goeppertianum (Kuhn) Kleb., 0,I on *Abies balsamea* (L.) Mill. associated with rusted *Vaccinium angustifolium* Ait., causing witches' brooms on the latter (see illust. in Ziller 1974 p. 183), near Geraldton (DAOM 184412), near Terrace Bay 48° 50'N 87° 05'W, near Kenora.

P. potentillae Kom., II on leaves of *Potentilla tridentata* Soland. Thunder Bay, Rossport and a number of exposed rocky sites along north shore of Lake Superior to *ca.* 47°N, [Vieux Comptoir 52° 37'N 78° 42'W, Great Whale River, Que.]. Telia have not been seen on any material from Ontario.

P. pustulatum (Pers.) Diet., II,III on *Epilobium glandulosum* Lehm. var. *adenocaulon* (Haussk.) Fern., near Little Pigeon Bay Lake Superior *ca.* 48° 07'N 89° 028'W, near Kapuskasing (DAOM 184413), Moosonee, [Eastmain *ca.*

52°N Que.]; *E. palustre* L., Thunder Bay Dist. 48° 20'N 88° 50'W (DAOM 184685) and 48° 45'N 86° 15'W, Sioux Narrows south of Kenora, Lake River, [Great Whale River, Que.]. Urediniospores are slightly smaller with thinner walls and more widely spaced wall spines than in *P. epilobii* (fide Savile, 1962). *P. pustulatum* attacks *Epilobium* section chamaenerion and *P. epilobii* goes to *Epilobium* section lysimachion plus *Clarkia* spp. and *Fuchsia* spp.

P. pyrolae Diet. ex Arth. 0,I not known. II, III on *Pyrola asarifolia* Michx., near Kapuskasing, Marathon; *P. secunda* L., Pickle Lake (DAOM 184485), [Churchill, Man., Rupert House and Gt. Whale River, Que.]. Elsehwere in Canada this rust occurs on other species of *Pyrola* and more rarely on *Chimphila umbellata* (L.) Nutt. and *Moneses uniflora* (L.) Gray. The specimen from Pickle Lake extends the Ontario distribution northward by 200 km.

P. sparsum (Wint.) E. Fischer, 0,I recorded on *Picea abies* (L.) Karst. in Europe, and Y. Hiratsuka (1970) successfully infected *Picea glauca* (Moench) Voss, *P. mariana* (Mill.) BSP. and *P. pungens* Engelm. from overwintered inoculum on rusted leaves of *Arctostaphylos rubra* (Rehd. ex Wils.) Fern. collected at Fort Smith, N.W.T. and at Banff, Alta. He described aeciospores as sublobose to ellipsoid, 19.5-32.3 x 13.2-21.8 um, wall colorless, 0.8 um thick, warts finely verrucose with an elongated smooth spot along one side. II,III on *Arctostaphylos rubra* (Rehd. ex Wils.) Fern., Lake River (DAOM 23990).

P. vaccinii (Wint.) Jorst. 0,I on *Tsuga* in DAOM from Algonquin Park. II,III on leaves of *Vaccinium vitis-idaea* L., Moosonee, Terrace Bay near Rossport (DAOM 114465), [Churchill, Man.]. Other blueberries become rusted in southern Ontario.

Tranzschelia fusca (Pers.) Diet. 0,III on *Anemone quinquefolia* L., (DAOM 23906) near Cochrane, Shabotik River 48° 56'N 85° 25'W, Moose Factory. An aecial state was also taken on the same date, 3 June 1949, at the Cochrane site; the aecia are systemic, bullate, with broadly ellipsoid spores, 20.5-44.5 x 14-19 um; wall pale, yellow-brown, 1.4-1.8 um thick, thicker at apex and closely set with coarse polygonal warts. In general appearance, this aecial infection (DAOM 145023) closely resembles the telial infection at the same site (DAOM 23906). It may be that there is a link between those 0,I and 0,III collections and possibly *T. fusca* has an unstable cycle; however the site has not been revisited for a follow-up on observation. The aecia are not those of *T. pruni-spinosae*.

T. pruni-spinosae (Pers.) Diet. 0,I on *Anemone quinquefolia* L., Shabotik River, Algoma Dist. (DAOM 115008), bearing identical collection data to *T. fusca* (above) from Shabotik River. Pycnia hypophyllous, conspicuous among aecia which are scattered, hypophylous, cupulate, coarsely lacerate; aeciospores subglobose, 23 - 27 x 20-23.5 um; wall 0.7 - 1.4 um thick, finely and minutely verrucose. This extends the known distribution in Ontario by 500 km north. Uredinia and telia occur on *Prunus* spp. known in Brant and Middlesex Co. southward.

Uredinopsis americana Syd. 0,I on current year needles of *Abies balsamea* (L.) Mill.; II,III on *Onoclea sensibilis* L., Timmins (DAOM 184687).

U. osmundae Magn. 0,I on *Abies balsamea* (L.) Mill.; II,III on *Osmunda claytoniana* L., Black Sturgeon Lake, near Atikoken (DAOM 140043).

U. phegopteridis Arth. 0,I on *Abies balsamea* (L.) Mill.; II,III on *Gymnocarpium dryopteris* (L.) Newm. var. *dryopteris* (= *Dryopteris disjuncta* (Ledeb.)Morton), Ouimet Canyon Thunder Bay Dist. (DAOM 115011) and Little Pic River NW of Marathon. Elsewhere in Canada rusted fir is known from New Glasgow, N.S. and Ste. Anne de Bellvue, Que. (cultures by W.P. Fraser) and from Petawawa, Renfrew Co., Ont. while specimens of rust on fern are from New Glasgow, N.S., Anticosti I., Que., Lake Temagami, Ont., Slave Lake, Alta. and Prince George, B.C.

Uromyces is similar to *Puccinia* except that teliospores are 1-celled rather than 2-celled. Hosts are predominantly in Fabaceae (Leguminosae).

Uromyces coloradensis Ell. & Ev., 0,I systemic, III scattered on *Vicia americana* Muhl., near Nipigon, Atikokan, Moosonee, Fort Albany; *V. cracca* L., Pagwa 50° 01'N 85° 13'W. Teliospore walls are minutely warted toward the apex of the spore in comparison with the totally smooth teliospores of *U. viciae-fabae* the more common rust of *Vicia* spp. *Uromyces coloradensis* ranges west from Ontario to British Columbia. The Moosonee-Ft. Albany specimens extend the known distribution in Ontario from Kenora.

U. fallens Kern ex Barth. (= U. trifolii (Hedw. f. ex DC.) Lév. in part) 0,II,III on *Trifolium pratense* L., near Black Sturgeon Lake. See Cummins (1978) for varietal treatment under *U. trifollii-repentis*.

U. hedysari-obscuri (DC.) Car. & Picc. 0,I,III, uredinia absent but secondary or repeating aecia may appear with the telia. Primary aecia occur in compact groups with the pycnia; on *Hedysarum alpinum* L. var. *americanum* Michx., Hearst (DAOM 184688), Moose Factory, Fort Albany, [Rupert River and

Harricanaw River, Que.]; *H. mackenzii* Richards; Lake River, Brant River in Polar Bear Prov. Park, Cape Henrietta Maria, Winisk (DAOM 184689), Fawn River, [Cape Jones 54° 37'N eastern James Bay, Que., Ft. Churchill, Man.]. Field association of rusted *H. suphurescens* Rydb. and *H. mackenzii* Richardson at Radium Hot Springs, B.C., indicated that this rust was attacking both hosts.

U. lineolatus (Desm.) Schroet. ssp. **nearcticus** Savile 0,I on [*Cicuta, Ligusticum, Sium*]; II,III on *Scirpus fluviatilis* (Torr.) Gray, Minaki. Morphological differences between other rusts of *Scirpus* including *Puccinia mcclatchieana* and *P. angustata* (*q.v.*) were given by Savile (1972). *U. lineolatus* was previously known in southern Ontario as far north as Carleton Co.

U. polygoni-avicularis (Pers.) Karst. 0,I,II,III on *Polygonum aviculare* L., Moosonee, Ogoki (DAOM 184693), Long Lac east of Geraldton. This rust is common across Canada, but was previously known in Ontario only as far north as Nipissing Dist.

U. punctatus Schroet. [0,I on *Euphorbia*, not known in North America] II,III localized infection on leaves of *Astragalus* sp., Kapuskasing (DAOM 184694). This is the first record from Ontario but it is recorded elsehwere in Canada, on *Oxytropis* spp.; see Fungi Candenses No. 24. Teliospores are uniformly and shallowly verrucose.

U. silphii Arth. [0,I on Asteraceae: *Aster, Helianthus, Silphium* not seen in northern Ont.] II,III on *Juncus brevicaudatus* (Engelm.) Fern., Black Sturgeon Lake (DAOM 184695). Elsewhere in Canada it attacks other *Juncus* spp.: *J. dudleyi* Wieg., southern Ontario and Quebec; *J. Longistylis* Torr., Prairie Provinces; *J. Tenuis* Willd., southern Ontario, Quebec and Maritime Provinces.

U. trifolii (Hedw. ex DC.) Fckl. III only on *Trifolium repens* L., Abitibi logging camp no. 149 49° 49'N 91° 32'W. A description and illustration is given by Cummins (1978).

U. trifolii-repentis Liro [0,I,] II,III on *Trifolium hybridum* L., Kapuskasing (DAOM 184418), Atikoken, Kenora. Cummins (1978) recognizes *Uromyces trifolii-repentis* Liro var. *trifolii-repentis* on *T. hybridum* and *T. repens* L. and also *U. trifolii - repentis* var. *fallens* (Arth.) Cumm. on *T. pratensis* L. as widely distributed wherever red clover is grown. He recognizes slight morphological differences and apparent host limitations that together seem to strengthen the argument for separate species (*cf. U. fallens*).

U. triquetrus Cooke 0,I,II,III on *Triadenum virginicum* (L.) Raf. (= *Hypericum virginicum* L.) Geraldton (DAOM 184420), Wabimeig Lake 51° 28'N 85° 36'W (DAOM 184416). These collections extend the known distribution in Ontario by some 500 km. north from Nipissing District. The aecial state of the heteroecious *U. sparganii* Cke. & Peck also attacks *T. virginicum*.

U. viciae-fabae Schroet. (= *U. fabae* (Grev.) DeBary ex Cke.) on *Lathyrus japonicus* Willd., Vermillion Bay west of Dryden; *L. ochroleucus* Hook., Kapuskasing (DAOM 184424), Nipigon, Black Sturgeon Lake, Sioux Narrows south of Kenora and Kenora; *L. venosus* Muhl., Atikoken, near Kenora; *Vicia cracca* L., Portage Island at junction Mattagami and Missinabi Rivers (DAOM 184421), Allan Water River 50° 15'N 90° 10'W, Kapuskasing. This circumglobal rust attacks other vetches, wild peas and *Pisum sativum* L.; *Lathyrus japonicus* and *L. venosus* are hosts new to Ontario. The race on *V. cracca* attacks *P. sativum* freely.

USTILAGINALES The smuts produce basidiospores from an overwintering or resting spore. Smuts are parasitic almost solely on herbaceous plants, typically appearing as soot-like masses of spores mainly on above ground plant parts but also on tubers, roots and rhizomes. Resting spores are formed from the mass of intercellular mycelium.

Anthracoidea (= Cintractia in part, see Kukkenen (1963, 1964) is localized in florets of mainly Caricoideae. *Cintractia* is systemic and fruits in the inflorescences of Cyperoideae and Juncaceae.

Anthracoidea americana (Nannf. & Lindeb.)Kukk. on *Carex atherodes* Spreng., Attawapiskat; *C. lanuginosa* Michx., near Moose Factory (DAOM 184699).

A. aspera (Liro) Kukk. on *Carex chordorrhiza* Ehrh., Lake River, Attawapiskat, [Fort George, Paul Bay 54° 03'N 79° 07'W, Que.].

A. atratae (Savile) Kukk. on *Carex miliaris* Michx., [Great Whale River, Que.]; *C. saxatilis* L., [Great Whale River, Que.]; *Carex* sp. Fort Albany (DAOM 184425). In Arctic Canada other *Carex* spp. esp. *C. aquatilis* Wahlenb. may support this smut. The specimen from Fort Albany is the first for Ontario.

A. bigelowii Nannf. apud Nannf. & Lindeb. on *Carex bigelowii* Torr., [Fort George, Great Whale River, Que.]; *C. salina* Wahlenb., [Roggan River 54° 25'N 79° 26'W, Que.].

A. **buxbaumii** Kukk. on *Carex buxbaumii* Wahlenb., Ignace (DAOM 184700). In Canada known from Nfld. to B.C. on this host but this is the first report for Ontario.

A. capillaris Kukk. on *Carex capillaris* L., [east coast of James and Hudson Bay, Que., at Paint Hills Bay 52° 58'N 78° 55'W, Cape Jones 54° 37'N 79° 41'W and Great Whale River] and [Fort Churchill, Man.]

A. caricis (Pers.) Bref. on *Carex glacialis* Mack., [Great Whale River, Que.]; *C. norvegica* Retz., [Great Whale River, Que.]. In other provinces and states, widely scattered on *Carex* spp. but especially common on *C. pensylvanica* L.

A. fishcheri (Karst.) Kukk., on *Carex atherodes* Spreng., Attawapiskat; *C. canescens* L., Polar Bear Prov. Park 55° 18'N 86° 25'W (DAOM 184701); *C. chordorrhiza* L., Little Postogoni Lake 49° 25'N 88° 03'W, Attawapiskat; *C. rostrata* Stokes, Moose Factory, Attawapiskat, [Fort George, Que.] and southward into Central Ontario.

A. heterospora (Lindeb.) Kukk. on *Carex aquatilis* Wahlenb., Mammamattawa (DAOM 184427), Upper English River 49° 50'N 91° 11'W, Smokey Falls (DAOM 184702), Lake River; *C. palacea* Wahlenb. [Vieux Comptoir 52° 33'N 78° 15'W, Fort George, Que.]; *C. salina* Wahlenb., [Eastmain River 52° 12'N 78° 12'W, Fort George, Que.]; *C. stricta* Lam., near Pagwa 50° 04'N 85° 09'W, near Hearst, Black Sturgeon Lake; *Carex* sp. near Black Sturgeon Lake. The specimens from Ontario are new records for the province.

A. karii (Liro) Nannf. on *Carex aenea* Fern. [Richmond Gulf 56° 20'N 76° 20'W, Que.]; *C. brunnescens* (Pers.) Poir., Twin Island James Bay 53° 18'N 80° 00'W (DAOM 144761), [Fort George and Great Whale River, Que.], Lake Nipigon; *C. gynocrates* Wormsk., Sibley Pen., Lake River (DAOM 25471), [Great Whale River, Que., Fort Churchill, Man.]; *C. praticola* Rydb., [Vieux Comptoir 52° 38'N 78° 42'W, Que.] and other *Carex* spp. elsewhere in Canada.

A. limosa (Syd.) Kukk. on *Carex limosa* L., Little Postagoni Lake 49° 25'N 88° 03'W (DAOM 83846), Lake River, [Eastmain, Rupert House, Fort George, Que.], [Gillam and Fort Churchill, Man.]; *C. magellanica* Lam., [Fort George, Que.]; *C. rariflora* (Wahlenb.) Sm., [Fort Churchill, Man.]; *C. salina* Wahlenb., [east coast James Bay 53° 09'N 78° 56'W, Que.].

A. lindebergiae (Kukk.) Kukk. on *Kobresia simpliciuscula* (Wahlenb.) Mack., [Cape Jones 54° 37'N 79° 41'W, Que. and Fort Churchill, Man.]; also from arctic Canada, Alaska and Greenland. This smut is unknown in Ontario But the host is recorded from Cape Henrietta Maria (Dutilly et al., 1954) and there are specimens in CAN from Hawley Lake and Sutton River.

A. paniceae Kukk. on *Carex livida* (Wahlenb.) Willd., [Paul Bay eastern James Bay 54° 03'N 79° 06'W and Roggan River 54° 25'N 79° 26'W, Que.]; *C. vaginata* Tausch [Great Whale River, Que. and Fort Churchill, Man.].

A. rupestris Kukk. on *Carex glacialis* Mack., Cape Henrietta Maria (DAOM 40157); *C. rupestris* Bell ex All., [Great Whale River, Que. and Fort Churchill, Man.].

A. scirpoideae Kukk. on *Carex scirpoidea* Michx., junction Winisk and Shamattawa Rivers *ca.* 55°N (DAOM 184428), Severn River 55° 30'N 88° W (DAOM 184707), Goose Creek 55° 55'N 87° 25'W, [Great Whale River, Que., Gillam and Fort Churchill, Man.]. The smut is recorded widely in Canada by Kukkonen (1963) but these are the first records from Ontario.

A. scirpi (Kuhn) Kukk. on *Trichophorum caespitosum* (L.) Hartm. (= *Scirpus caespitosus* L.); [Great Whale River, Manitounuk I. 55° 40'N 77° 20'-40'W, Que.].

A. subinculusa (Koern.) Bref. on *Carex miliaris* Michx. [Fort George and Great Whale River, Que.]; *C. saxatilis* L. [Fort Churchill, Man.]; *C. vesicaria* L., Lake Nipigon region and southward.

A. turfosa (Syd.) Kukk. on *Carex exilis* Dewey, [Fort George, Que.]; sedges susceptible to this smut also take the small-spored A. karii (Nannfeldt 1979).

Cintractia taubertiana (Henn.) Clint. on *Rhyncospora alba* (L.) Vahl., [Eastmain River 52° 12'N 78° 12'W, Que.]. In recognizing the smut genus *Anthracoidea* Brefeld, Kukkonen (1963) indicated that the sorus had no sterile stroma and that the sporogenous hyphae are transformed in total into spores; whereas, in the genus *Cintractia* spores are formed on a sterile stroma and sterile hyphae ramify through the spore mass.

Doassansia sagittariae (Westend.) Fisch. on *Sagittaria latifolia* Willd., near Kapuskasing (DAOM 184430), near Smooth Rock Falls. Infection causes conspicuous, brown, elliptical leaf spots *ca.* 5 mm diam. and visable on both surfaces; spore balls are embedded in the spots.

Entyloma lineatum (Cke.) Davis on *Zizania aquatica* L., near Dryden (DAOM 140064). It forms dark, elliptical spots *ca.* 5 mm diam. which may coalesce to form extensive blackened areas on leaves and culmns. Masses of single spores are borne within these spots. Previously known as far north as Muskoka Dist.

E. ficariae Fisch. v. Waldh. on *Ranunculus pensylvanica* L., Minaki (DAOM 150638). Recorded in Bisby et al. (1938) as E. ranunculi (Bon.) Schroet. on *R. macounii* Britt.

E. veronicae (Wint.) Lagerh. on *Veronica americana* (Raf.) Schw., [Rupert House, Que.].

Schizonella pusilla (Cke. & Peck) Cif. on *Carex bigelowii* Torr., [Great Whale River, Que.]; *C. scirpoidea* Michx. [Great Whale River, Que.] Smut sori appear as black, compact, agglutinated, linear, spore masses on leaves. Spores mostly occur in pairs. Known in southern Ontario as far north as Muskoka Dist. but with both above hosts known to 55°N in Ontario, smut is expected to be found much farther north.

Urocystis agropyri (Preuss.) Schroet. on *Elymus mollis* Trin., [Great Whale River, Que.]. Spore balls (1-6 cells) surrounded by a layer of sterile cells are borne in linear, black, sori on leaves and culms of a number of other grass genera including: *Agropyron*, *Bromus*, *Glyceria*, *Poa*, *Trisetum* and *Triticum*..

U. anemones (Pers.) Wint. on *Anemone quinquefolia* L., Moose Factory (DAOM 34080). [Fort Chimo, Ungava Que. on *A. parviflora* Michx.]. It is known also on *Ranunculus* spp. in western Canada and north to Yukon and Alaska.

U. occulta (Wallr.) Rab. on *Secale cereale* L., Kapuskasing (DAOM 163002). Rare in Northern Ontario.

Ustilago bullata Berk. on *Bromus ciliatus* L., [Vieux Comptoir 52° 37'N 78° 42'W, Que.]. Common in more southern areas of Ontario and Quebec. especially on *Hordeum jubatum* L. and *Bromus tectorum* L. The single-celled spores are formed within dusty sori in all above-ground parts of the host.

U. calamagrostidis (Fckl.) Clint. (= U. striiformis auct.) on *Calamagrostis canadensis* (Michx.) Beauv., [Great Whale River, Que.].

U. cilinodis Savile (= *U. anomala* auct.) on *Polygonum cilinode* Michx., Fort Francis (DAOM 5882), Minaki, Fort Hope 51° 34'N 87° 59'W (DAOM 34366). This smut occurs south through Temagami and areas bordering the St. Lawrence River to New York State. Conners (1967) lists 6 species of *Ustilago* on *Polygonum* in Canada.

EXOBASIDIACEAE These parasitic fungi attack above ground plant parts often causing some distortion and discoloration. The fungus emerges from within (the leaf) to form a shallow, white mat of basidia and basidiospores.

Exobasidium vaccinii Wor. on *Vaccinium angustifolium* Ait., Kapuskasing (DAOM 184557), east of Kenora, Abitibi Canyon, Nakina (DAOM 184556); *V. myrtillioides* Michx., near Savant Lake, Pickle Lake (DAOM 184555); *V.vitis-idaea* L., Terrace Bay 48° 46'N 87° 07'W; *Vaccinium* sp., Kenora. *E. vaccinii* is established in other provinces on the same hosts but these records are the first for Ontario.

CORTICIACEAE Mainly saprophytic fungi on woody stems and branches and producing non-septate basidia from a thin weft of superficial mycelium. A few species are known to be parasitic.

Ceratobasidium anceps (Bres. & Syd.) Jackson on *Clintonia borealis* (Ait.) Raf., Sandy Lake *ca.* 53°N 93°W (DAOM 184708). A full description of the fungus and its effect on this host and others like *Dryopteris*, *Pteridium*, *Trientalis*, *Cornus* and *Aralia* has been given by Jackson (1949). Diseased leaves or pinnae become brown and brittle proceeding from the tip toward the base. The fungus becomes conspicuous on the undersurface, especially at the advancing margin of the necrosis, as a spreading, white, floccose mycelium. Inoculation tests done in the field indicated to Jackson that the fungus was able to progress from one host to another. All hosts are woodland hebacious plants and the collection from Sandy Lake is a considerable northward extension from the Temagami region where most of Jackson's observations were made.

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HOST INDEX

names in brackets are fungi not yet found in Northern Ontario but are reported or known from adjacent areas of Manitoba and Quebec.

Abies

Melampsorella caryophyllacearum

Milesia

[Pucciniastrum epilobii]

Pucciniastrum goeppertianum

Tiarosporella abietis

Toxosporium camptospermum

[Uredinopsis americanum]

Uredinopsis osmundae

[Uredinopsis phegopteridis]

Acer

Cristulariella depraedans

Gloeosporium apocryptum

Hypoxylon mammatum

Nectria cinnabarina

Phyllactinia guttata

Phyllosticta minutissima

Rhytisma punctatum

[Tubercularia vulgaris]

Uncinula circinata

Achillea

Erysiphe cichoracearum

[Puccinia millefolia]

Agropyron

Claviceps purpurea

Puccinia recondita

Agrimonia

Pucciniastrum agrimoniae

Agrostis

[Puccinia poae-nemoralis]

Alisma

Physoderma maculare

Alnus

Erysiphe aggregata

[Hyoxylon mammatum]

Microsphaera penicillata

Phyllactinia guttata

Taphrina robinsoniana

[Tubercularia vulgaris]

Althaea

Puccinia malvacearum

Amelanchier

Apiosporina collinsii

Entomosporium mespili

Gloeosporium sp.

Gymnosporangium clavariiforme

Gymnosporangium clavipes

Gymnosporangium cornutum

Gymnosporangium nelsonii

Lophodermium tumidum

Podosphaera clandestina

Andromeda

Placuntium andromedae

Anemone

Erysiphe polygoni

Plasmopara pygmaea

Puccinia anemones-virginianae

[Puccinia pulsatillae]

Puccinia recondita

Tranzschelia anemones

Tranzschelia pruni-spinosae

[Urocystis anemones]

Arabis

Puccinia holboelii

[Puccinia Thlaspeos]

Aralia

[Ceratobasidium anceps]

Nyssopsora clavellosa

[Tubercularia vulgaris]

Arctostaphylos

Chrysomyxa arctostaphyli

Pucciniastrum sparsum

Arenaria

Puccinia arenariae

Aronia

[Entomosporium mespili]

[Gymnosporangium clavipes]

Artemisia

Albugo tragopogonis

Asarum

Synchytrium asari

Aster

Coleosporium asterum

Erysiphe cichoracearum

Puccinia asteris

Puccinia dioicae

Uromyces silphii]

Astragalus

Uromyces punctatus

Avena

Puccinia coronata

Puccinia graminis

Berberis

[Puccinia graminis]

Betula

Atopospora betulina

[Hypoxylon mammatum]

[Melampsoridium betulinum]

Microsphaera penicillata

Phyllactinia guttata

Phyllosticta betulae

Septoria betulae

Septoria betulicola

Taphrina americana

Taphrina carnea

[Taphrina nana]

[Tubercularia vulgaris]

Bidens

Sphaerotheca fuliginea

Bromus

Claviceps purpurea

[Ustilago bullata]

Calamagrostis

Claviceps purpurea

Puccinia coronata

[Ustilago calamagrostidis]

Caltha

Puccinia calthae

Carex

Anthracoidea americana

Anthracoidea aspera

Anthracoidea atratae

[Anthracoidea bigelowii]

Anthracoidea buxbaumii

[Anthracoidea capillaris]

Anthracoidea caricis

Anthracoidea fisheri

Anthracoidea heterospora

[Anthracoidea karii]

[Anthracoidea limosae]

[Anthracoidea paniceae]

Anthracoidea rupestris

Anthracoidea scirpoidea

Anthracoidea subinclusa

Anthracoidea turfosa

Hysteropezizella diminuens

Hysteropezizella macrospora

Puccinia bolleyana

Puccinia caricina

Puccinia caricis-shepherdiae

Puccinia dioicae

Puccinia karelica ssp. laurentiana

Puccinia limosae

Puccinia uniporula

[schizonella pusilla]

Cerastium

[Melampsorella caryophyllacearum]

Chamaedaphne

Chrysomyxa ledi

Gibbera pulchella

Chelone

Erysiphe polygoni

Cicuta

Puccinia bistortae

[Uromyces lineolatus]

Cirsium

Puccinia cnici

Puccinia laschii var. laschii

Puccinia punctiformis

Clematis

Puccinia recondita

Clarkia

[Pucciniastrum epilobii]

Clintonia

Ceratobasidium anceps

Comandra

Cronartium comandrae

Coptis

Mycosphaerella coptis

Cornus

[Ceratobasidium anceps]

Glomopsis corni

Phyllactinia guttata

Puccinia porphyrogenita

Corydalis

Peronospora corydalis

Corylus

[Hypoxylon mammatum]

Phyllactinia guttata

Septoria corylina

Crataegus

[Entomosporium mespili]

[Gymnosporangium clavipes]

Cydonia

[Entomosporium mespili]

Cystopteris

Hyalopsora polypodii

Deschampsia see **Vahlodea**

Draba

Puccinia drabae

[Puccinia drabicola]

[Puccinia holboellii]

Sphaerotheca fuliginea

Dryopteris see also **Gymnocarpium**

Milesia fructuosa

[Ceratobasidium anceps]

Eleocharis

Claviceps nigricans

Elymus

Claviceps purpurea

Urocystis agropyri

Empetrum

Chrysomyxa empetri

Epigaea

Microsphaera vaccinii

Epilobium

Puccinia epilobii

Pucciniastrum epilobii

Pucciniastrum pustulatum

Erigeron

Sphaerotheca fuliginea

Erysimum

[Puccinia holboellii]

Eupatorium

Erysiphe cichoracearum

Euphorbia

Uromyces punctatus

Euphrasia

Ascochyta sp.

Fagus

Hypoxylon mammatum

Fragaria

Marssonina canadensis

Marsonina fragariae

Fraxinus

Phyllactinia guttata

Fuchsia

Pucciniastrum epilobii

Galium

Hainesia borealis

Puccinia punctata var. punctata

Puccinia punctata var. troglodytes

Puccinia rubefaciens

Gentiana

Puccinia haleniae

Geocaulon

[Cronartium comandrae]

Puccinia comandrae

Geranium

[Puccinia polygoni-amphibii]

Geum

Sphaerotheca macularis

Gymnocarpium see also **Dryopteris**

Uredinopsis phegopteridis

Habenaria

[Puccinia praegracilis var. connersii]

Halenia

Botrytis cinerea

Puccinia haleniae

Hedysarum

Uromyces hedysari-alpini

Uromyces hedysari-obscuri

Helianthus

Plasmopara halstedii

Puccinia helianthi

Helianthus (Cont'd)

Septoria helianthi

[Uromyces silphii]

Heuchera

Puccinia saxifragae var.heucharum

Hieracium

Erysiphe cichoracearum

[Puccinia columbiense]

[Puccinia fraseri]

Hordeum

Puccinia graminis

[Ustilago bullata]

Hypericum see **Triadenum**

Juncus

Claviceps junci

Uromyces silphii

Juniperus

Gymnosporangium clavariiforme

Gymnosporangium clavipes

Gymnosporangium corntum

Gymnosporangium nelsonii

Lophodermium juniperinum

Kalmia

[Gibbera kalmiae]

Mycosphaerella colorata

Kobresia

[Anthracoidea lindebergiae]

Lactuca

Erysiphe cichoracearum

Puccinia minussensis

Lathyrus

Microsphaera penicillata

[Physoderma lathyri]

Uromyces viciae-fabae

Ledum

Chrysomyxa ledi

Chrysomyxa ledicola

Lophodermium sphaerioides

Ligusticum

[Uromyces lineolatus]

Linnea

Metacoleroa dickiei

Linum

Melampsora lini

Lonicera

Kabatia lonicerae var. americana

Microsphaera penicillata

Lycopus

Puccinia angustata

[Puccinia menthae]

Malus

[Entomosporium mespili]

[Gymnosporangium clavipes]

[Podosphaera clandestina]

[Podosphaera leucotricha]

Malva

[Puccinia malvacearum]

Medicago

Pseudopeziza trifolii

[Stagonospora meliloti]

Melilotus

Stagonospora meliloti

Mentha

Erysiphe cichoracearum

[Puccinia angustata]

Puccinia menthae

Mertensia

Erysiphe cichoracearum

Mitella

Puccinia heucherae var. minor

Moneses

Chrysomyxa pirolata

[Pucciniastrum pyrolae]

Muhlenbergia

Phyllachora vulgata

Myrica

Cronartium comptoniae

Ramularia destructiva

Oenothera

Erysiphe polygoni

Puccinia dioicae

Septoria oenotherae

Onoclea

Uredinopsis americana

Oryzopsis

Cladosporium phlei

Osmorrhiza

Puccinia pimpinellae

Osmunda

Uredinopsis osmundae

Oxalis

[Puccinia sorghi]

Oxytropis

[Puccinia punctatus]

Parthenocissus

Phyllosticta viticola

Uncinula nectar

Petasites

Puccinia conglomerata

Phleum

Puccinia graminis

Picea

Botrytis cinerea

Chrysomyxa arctostaphyli

[Chrysomyxa empetri]

Chrysomyxa ledi var. cassandrae

Chrysomyxa ledi var. groenlandici

Chrysomyxa ledicola

Chryxomyxa pirolata

Chrysomyxa weirii

Gremeniella abietina

Pucciniastrum americanum

[Pucciniastrum arcticum]

Pinus

Botrytis cinerea

Coleosporium asterum

Coleosporium viburni

Cronartium comandrae

Cronartium comptoniae

Cronartium ribicola

Endocronartium harknessii

Gremmeniella abietina

Lophodermium pinastri

Sirococcus strobilinus

Pisum

Septoria flagellifera

Septoria pisi

[Uromyces viciae-fabae]

Plantago

Erysiphe cichoracearum

Poa

Erysiphe graminis

Puccinia poae-nemoralis

Polygonum

Erysiphe polygoni

[Puccinia bistortae]

Puccinia polygoni-amphibii

Septoria polygonorum

Uromyces polygoni-avicularis

Ustilago cilinodis

Populus

Cucurbitaria staphulae

Hypoxylon mammatum

Macrophoma tumefaciens

Marssonina populi

Melampsora medusae

Mycosphaerella populicola

Mycosphaerella populorum

Phyllosticta brunea

Pollaccia elegans

Pseudodichomera see Macrophoma

Septoria musiva

Septoria populicola

Uncinula adunca

Potentilla

Marssonina potentillae

Phragmidium andersoni

[Phragmidium ivesiae]

Pucciniastrum potentillae

Ramularia arvensis

Septogloeum potentillae

Sphaerotheca macularis

Prenanthes

Puccinia orbicula

Prunus

Apiosporina collinsii

Blumeriella jaapii

Cylindrosporium prunophorae

Nectria cinnabarina

Phyllosticta virginiana

Scopinella sphaerophila

Taphrina cerasi

Taphrina communis

[Tranzschelia pruni-spinosae]

Tubercularia vulgaris

Pteridium

[Ceratobasidium anceps]

Pyrola

Cercospora sp.

Chrysomyxa pirolata

Pucciniastrum pyrolae

Pyrus

[Entomosporium mespili]

Quercus

[Tubercularia vulgaris]

Ranunculus

Entyloma ficariae

Erysiphe polygoni

Puccinia recondita

[Urocystis anemones]

Rhamnus

Puccinia coronata

Rhyncospora

[Cintractia taubertiana]

Ribes

[Cronartium ribicola]

Puccinia caricina

Puccinia pringsheimiana

Puccinia ribis

[Puccinia uniporula]

Septoria aurea

Sphaerotheca mors-uvae

Rosa

Phragmidium americanum

Phragmidium fusiforme

Phragmidium speciosum

Rubus

Coleroa rubicola

Gymnoconia peckiana

[Phragmidium arcticum]

Phragmidium occidentale

Phragmidium rubi-idaei

Pucciniastrum americanum

Pucciniastrum arcticum

Sphaerotheca macularis

Sagittaria

Doassansia sagittariae

Salix

[Hypoxylon mammatum]

Melampsora abieti-capraearum

Melampsora epitea

Melampsora paradoxa

Physalopsora miyabeana

Pollaccia saliciperda

Ramularia rosea

Rhytisma salicinum

Septoria salicicola

[Tubercularia vulgaris]

Uncinula adunca

Sambucus

Puccinia bolleyana

Satureja

[Puccinia menthae]

Saxifraga

Puccinia pazschkei var. oppositifolia

Puccinia saxifragae var. curtipes

Scirpus see also **Trichophorum**

Cladosporium sp.

Puccinia angustata

Puccinia mcclatchieana

Uromyces lineolatus ssp. nearcticus

Scutellaria

Erysiphe cichoracearum

Secale

Urocystis occulta

Shepherdia

Puccinia caricis-shepherdiae

Septoria shepherdia

Silphium

[Uromyces silphii]

Sium

Puccinia bistortae

[Uromyces lineolatus]

Solidago

Coleosporium asterum

Erysiphe cichoracearum

Puccinia dioicae

[Puccinia grindeliae]

Sonchus

Septoria sonchi-arvensis

Septoria sonchifolia

Sorbus

Diplocarpon mespili

Entomosporium mespili

[Gymnosporangium clavipes]

Gymnosporangium cornutum

Taraxacum

Puccinia hieracii

Sphaerotheca fuliginea

Thalictrum

Puccinia recondita

Tilia

[Tubercularia vulgaris]

Triadenum

[Uromyces sparganii]

Uromyces triquetrous

Trichophorum see also **Scirpus**

[Anthracoidea scirpi]

Trientalis

[Ceratobasidium anceps]

Puccinia karelica ssp. laurentiana

Septoria increscens

Trifolium

Erysiphe polygoni

[Stagonospora meliloti]

Uromyces fallens

Uromyces trifolii

Uromyces trifolii-repentis

Trisetum

[Puccinia poae-nemoralis]

Triticum

Puccinia graminis

Tsuga

[Pucciniastrum vaccinii]

Ulmus

Ceratocystis ulmi

[Tubercularia vulgaris]

Vaccinium

Exobasidium vaccinii

Exobasidium sp.

[Lophodermium maculare]

Lophodermium melaleucum

Microsphaera vaccinii

Pucciniastrum goeppertianum

Pucciniastrum myrtilli

Pucciniastrum vaccinii

Vahlodea

[Puccinia praegracilis var. connersii]

Veronica

[Entyloma veronica]

Viburnum

Coleosporium viburni

Microsphaera penicillata

Puccinia linkii

Vicia

Uromyces coloradensis

Uromyces viciae-fabae

Viola

Puccinia violae

Septoria violae

Synchytrium sp.

Vitis

[Phyllosticta viticola]

Waldsteinia

Septoria waldsteiniae

Zea

Puccinia sorghi

Zizania

Entyloma lineatum

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	× 0.04	inch
centimetre (cm)	× 0.39	inch
metre (m)	× 3.28	feet
kilometre (km)	× 0.62	mile
AREA		
square centimetre (cm^2)	× 0.15	square inch
square metre (m^2)	× 1.2	square yards
square kilometre (km^2)	× 0.39	square mile
hectare (ha)	× 2.5	acres
VOLUME		
cubic centimetre (cm^3)	× 0.06	cubic inch
cubic metre (m^3)	× 35.31	cubic feet
cubic metre (m^3)	× 1.31	cubic yards
CAPACITY		
litre (L)	× 0.035	cubic foot
hectolitre (hL)	× 22	gallons
hectolitre (hL)	× 2.5	bushels
WEIGHT		
gram (g)	× 0.04	oz avdp
kilogram (kg)	× 2.2	lb avdp
tonne (t)	× 1.1	short tons
AGRICULTURAL		
litres per hectare (L/ha)	× 0.089	gallons per acre
litres per hectare (L/ha)	× 0.357	quarts per acre
litres per hectare (L/ha)	× 0.71	pints per acre
millilitres per hectare (mL/ha)	× 0.014	fl. oz per acre
tonnes per hectare (t/ha)	× 0.45	tons per acre
kilograms per hectare (kg/ha)	× 0.89	lb per acre
grams per hectare (g/ha)	× 0.014	oz avdp per acre
plants per hectare (plants/ha)	× 0.405	plants per acre

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